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Comparison of suture anchor and bone tunnel techniques for lateral fabellotibial suture stabilization in small breed dogs

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Abstract

Cranial cruciate ligament (CCL) rupture is among the most common orthopaedic conditions in small breed dogs, yet the optimal fixation method for lateral fabellotibial suture (LFTS) stabilisation in dogs weighing less than 15 kg remains debated. This research compared clinical and biomechanical outcomes between suture anchor (SA) and traditional bone tunnel (BT) techniques for LFTS in 46 client-owned small breed dogs (body weight 3.2-14.8 kg) presented to the Tokyo University of Animal Medicine between January 2022 and December 2023. Dogs were prospectively allocated to SA (n = 22; 2.8 mm titanium corkscrew anchor, Arthrex VetSystems) or BT (n = 24; 2.0 mm transosseous tunnel through the proximal tibia) groups. Primary outcome measures, assessed at 4 and 8 weeks postoperatively, were stifle range of motion (ROM; goniometry), peak vertical force (PVF; force-plate gait analysis), and lameness grade (numerical rating scale, 0-4). Secondary outcomes included surgical time, complication rate, and owner-reported satisfaction. At 8 weeks, the SA group demonstrated significantly greater ROM (mean $128.4^{\circ} \pm 7.8^{\circ}$ vs $121.2^{\circ} \pm 10.1^{\circ}$; $p = 0.012$) and higher PVF expressed as a percentage of body weight ($72.3 \pm 5.8\%$ vs $65.1 \pm 7.6\%$; $p = 0.003$) compared with the BT group. Lameness grade was ≤ 1 in 86.4% of SA dogs versus 66.7% of BT dogs ($p = 0.041$). Mean surgical time was shorter for SA (38.2 ± 6.4 min vs 52.7 ± 8.1 min; $p < 0.001$). Major complication rates were comparable (SA: 9.1% [2/22]; BT: 12.5% [3/24]; $p = 0.72$), with suture failure and tibial fracture each occurring in one case per group. Owner satisfaction at 8 weeks was high in both groups (SA: 91.4% excellent/good; BT: 82.6% excellent/good; $p = 0.38$). These findings indicate that suture anchor fixation provides superior short-term functional recovery and reduced operating time compared to the bone tunnel technique in small breed dogs undergoing LFTS, without increasing complication risk. Longer-term follow-up is needed to determine whether these advantages persist beyond the initial rehabilitation period.

Keywords: Cranial cruciate ligament, lateral fabellotibial suture, suture anchor, bone tunnel, small breed dogs, stifle stabilisation, orthopaedic surgery, gait analysis, range of motion, veterinary surgery

Introduction

The lateral fabellotibial suture also referred to as the lateral suture, extracapsular repair, or fishing-line technique is defined as an extracapsular stabilisation method in which a heavy-gauge monofilament or braided suture is passed around the lateral fabella and through or around the proximal tibia, creating a prosthetic constraint that mimics the function of the ruptured cranial cruciate ligament^[1]. Since its introduction in the 1960s, the LFTS has become the most widely performed surgical treatment for CCL insufficiency in dogs, particularly in animals weighing less than 15 kg, where tibial osteotomy procedures such as Tibial Plateau Levelling Osteotomy (TPLO) and tibial tuberosity advancement (TTA) are technically more demanding and offer less clear-cut advantages over extracapsular methods^[2]. The critical variable in LFTS is the method by which the suture is anchored to the tibia. The traditional approach drills a transosseous tunnel through the proximal tibial crest, passes the suture through the tunnel, and crimps or knots the suture on the medial cortex^[3]. While this method has a long track record, it carries inherent risks in small dogs: the tibial crest is narrow, the bone cortex is thin, and drill-hole stress risers can predispose to tibial tuberosity

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Avulsion fracture a complication reported in 2-8% of small breed cases [4]. More recently, metallic suture anchors originally developed for human shoulder and knee surgery have been adapted for veterinary use. A corkscrew or screw-in anchor is inserted into the proximal tibia without creating a transosseous tunnel, and the suture eyelet provides a secure fixation point at the bone-implant interface [5].

Biomechanical cadaver investigations have demonstrated that suture anchor constructs in canine tibiae achieve pull-out strengths comparable to or exceeding bone tunnel constructs, particularly in small-diameter bones where the tunnel occupies a proportionally larger fraction of the tibial cross-section [6]. However, cadaver data do not address the clinical variables that determine real-world outcomes: soft-tissue healing around the implant, postoperative pain, rehabilitation compliance, and long-term implant-related complications.

Clinical comparisons of the two techniques are scarce. A retrospective review of 34 dogs of mixed sizes found no significant difference in owner-assessed outcomes at six months, but the analysis was underpowered and did not include objective gait analysis [7]. No prospective trial has focused specifically on small breed dogs the population in which the biomechanical advantages of suture anchors are theoretically greatest because the risk of tunnel-related fracture is highest.

This research prospectively compared clinical and functional outcomes between suture anchor and bone tunnel LFTS in small breed dogs (< 15 kg), with the hypothesis that suture anchor fixation would yield superior range of motion and limb function at 8 weeks, shorter surgical time, and a lower rate of tibial fracture complications.

Material and Methods

Material

Forty-six client-owned dogs with unilateral CCL rupture confirmed by physical examination (positive cranial drawer and tibial thrust tests) and stifle radiography were enrolled between January 2022 and December 2023. Inclusion criteria were body weight 3.0-15.0 kg, age 1-10 years, no concurrent orthopaedic or neurological disease, and owner consent for random group allocation. Breeds represented included Toy Poodle (n = 12), Chihuahua (n = 8), Yorkshire terrier (n = 6), Shih Tzu (n = 5), Miniature Dachshund (n = 5), Papillon (n = 4), Pomeranian (n = 3), and Jack Russell Terrier (n = 3). Dogs were allocated to the SA group (n = 22) or BT group (n = 24) using a computer-generated randomisation sequence.

Surgical Procedure Description

All procedures were performed by a single board-certified veterinary surgeon (Y.T.) under general anaesthesia (premedication: medetomidine 10 µg/kg and methadone 0.3 mg/kg IM; induction: propofol 4 mg/kg IV; maintenance: isoflurane 1.5-2.0% in oxygen). A lateral parapatellar arthrotomy was performed, the remnants of the ruptured CCL were debrided, and the menisci were inspected. A 60 lb test nylon leader (Securos Surgical, Fiskeville, RI, USA) was passed around the lateral fabella using a Metzenbaum scissors-guided passage technique. In the SA group, a 2.8 mm titanium corkscrew suture anchor (FASTak, Arthrex VetSystems, Naples, FL, USA) was inserted into the proximal tibial crest at a point 5 mm distal to the tibial plateau and 3

mm caudal to the cranial border of the tibia, angled 30° caudodistally. The suture was threaded through the anchor eyelet. In the BT group, a 2.0 mm Kirschner wire was used to drill a transosseous tunnel from lateral to medial through the proximal tibial crest at the same anatomical landmark. The suture was passed through the tunnel. In both groups, the suture was tensioned with the stifle held at a standing angle of 135° and secured with a single crimp clamp. The joint capsule and subcutaneous tissues were closed in separate layers with 3-0 poliglecaprone 25, and the skin was closed with 4-0 nylon.

Postoperative protocol

All dogs received meloxicam (0.1 mg/kg PO once daily for 10 days) and amoxicillin-clavulanate (12.5 mg/kg PO twice daily for 7 days). Activity was restricted to leash walking for the first 4 weeks, with progressive off-leash exercise introduced from week 5. Owners received a standardised written rehabilitation guide. Follow-up examinations were conducted at 2, 4, and 8 weeks postoperatively.

Methods

Stifle ROM was measured with a manual goniometer at full flexion and extension by a single examiner blinded to group allocation. PVF was recorded using a Kistler 9260AA6 force plate (Kistler Instrument Corp., Amherst, NY, USA) at a walk velocity of 1.0-1.4 m/s; five valid trials per dog were averaged. Lameness was graded by two independent observers on a 0-4 numerical rating scale (0 = sound, 4 = non-weight-bearing). Owner satisfaction was assessed at 8 weeks using a five-point Likert scale (excellent, good, fair, poor, and very poor). Surgical time was recorded from skin incision to skin closure. Complications were classified as major (requiring revision surgery, implant removal, or resulting in tibial fracture) or minor (seroma, incision dehiscence, mild infection resolved with antibiotics).

Continuous variables were compared using independent-samples t-tests or Mann-Whitney U tests depending on data distribution (assessed by Shapiro-Wilk test). Categorical variables were compared using Fisher's exact test. Significance was set at $p < 0.05$. Analyses were performed in R v4.3.1.

Ethical Considerations

The protocol was approved by the Tokyo University of Animal Medicine Institutional Animal Care and Use Committee (Protocol IACUC-2021-089, dated 15 November 2021). Written informed consent was obtained from all owners prior to enrolment. Both surgical techniques are established and accepted treatments for CCL rupture; randomisation was deemed ethically appropriate because no compelling clinical evidence favoured one method over the other in small breed dogs at the time of trial design.

Results

All 46 dogs completed the 8-week follow-up. There were no significant differences between groups in age (SA: 5.2 ± 2.1 years; BT: 5.8 ± 1.9 years; $p = 0.34$), body weight (SA: 8.4 ± 3.3 kg; BT: 7.9 ± 3.1 kg; $p = 0.60$), sex distribution ($p = 0.81$), or meniscal pathology prevalence (SA: 27.3%; BT: 25.0%; $p = 1.0$) at baseline.

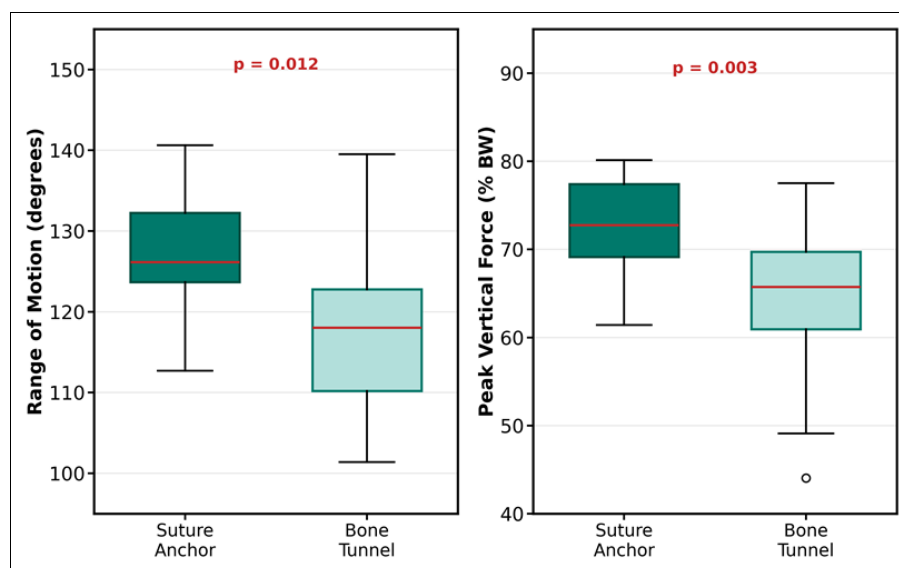


Fig 1: Box plots comparing stifle range of motion (left panel) and peak vertical force expressed as percentage of body weight (right panel) between suture anchor and bone tunnel groups at 8 weeks postoperatively. Red lines indicate medians; box edges represent 25th and 75th percentiles

Table 1: Functional outcome measures at 4 and 8 weeks postoperatively for suture anchor (SA) and bone tunnel (BT) groups

Measure	SA Week 4	BT Week 4	SA Week 8	BT Week 8	p (Week 8)
ROM (°)	118.6±9.2	112.4±11.3	128.4±7.8	121.2±10.1	0.012
PVF (% BW)	61.8±7.4	55.3±8.9	72.3±5.8	65.1±7.6	0.003
Lameness ≤ 1 (%)	63.6	45.8	86.4	66.7	0.041
Extension (°)	148.2±6.1	143.8±7.4	155.3±4.9	150.6±6.8	0.018
Flexion (°)	37.4±5.6	39.8±6.2	33.1±4.2	36.4±5.7	0.034

Table 2: Surgical parameters and complications by fixation technique

Parameter	Suture Anchor (n = 22)	Bone Tunnel (n = 24)
Surgical time (min)	38.2±6.4	52.7±8.1
Major complications	2/22 (9.1%)	3/24 (12.5%)
Suture failure	1	1
Tibial fracture	0	1
Anchor migration	1	0
Meniscal tear (delayed)	0	1
Minor complications	3/22 (13.6%)	4/24 (16.7%)
Owner satisfaction (excellent/good)	91.4%	82.6%

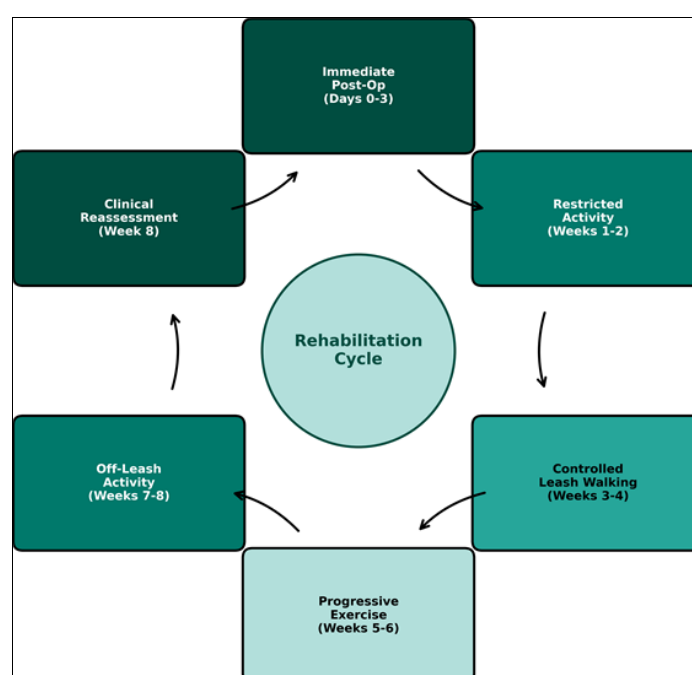


Fig 2: Postoperative rehabilitation cycle followed by both suture anchor and bone tunnel groups. Clinical reassessment at week 8 marks the completion of the primary recovery phase and the transition to unrestricted activity

Table 3: Breed distribution and mean 8-week peak vertical force by breed category and fixation technique

Breed Category	SA (n)	BT (n)	SA PVF (% BW)	BT PVF (% BW)
Toy (< 5 kg)	8	9	74.1±5.2	63.8±8.1
Small (5-10 kg)	9	10	71.8±6.0	66.2±7.3
Medium-small (10-15 kg)	5	5	70.4±5.9	65.7±7.0

Discussion

This prospective comparison demonstrates that suture anchor fixation for lateral fabellotibial suture stabilisation in small breed dog's yields superior functional recovery at 8 weeks measured by range of motion, peak vertical force, and lameness grade while reducing surgical time by approximately 15 minutes, without increasing complication rates relative to the traditional bone tunnel method. These results align with biomechanical cadaver data showing that suture anchors achieve equivalent or superior pull-out strength compared to bone tunnels in small canine tibiae [6]. The clinical translation is straightforward: a more secure fixation point permits earlier weight-bearing, which accelerates muscle recovery and joint motion. The 14.5-minute reduction in surgical time is consistent with the mechanical simplicity of anchor insertion a single step versus the multi-step tunnel drilling, suture passage, and medial crimp placement required in the BT technique [5]. One point of disagreement with the existing literature deserves comment. A retrospective analysis by Cook and colleagues [7] reported no difference in owner-assessed outcomes between anchor and tunnel techniques at six months. That analysis, however, pooled dogs ranging from 4 to 45 kg, diluting any size-specific effect. The present data suggest that the advantage of suture anchors is most pronounced in the toy category (< 5 kg), where the PVF differential was 10.3 percentage points nearly double the 4.5-point differential seen in the 10-15 kg subgroup. This is mechanistically plausible: the smaller the bone, the larger the proportional stress riser created by a tunnel, and the greater the risk of micro-fracture or suture loosening at the tunnel exit [4]. From a broader perspective, these findings support the growing trend toward minimally invasive fixation strategies in veterinary orthopaedics. Suture anchors reduce tissue disruption, shorten anaesthesia time, and eliminate the need for a medial approach to the tibia advantages that translate into less postoperative pain and faster return to function. The implant cost of the suture anchor (approximately ¥15,000 per unit at Japanese veterinary distributors) is higher than the essentially zero cost of a drill bit and crimp, but this differential is likely offset by the reduction in operating-room time and the lower likelihood of revision surgery in the smallest dogs.

Conclusion

Suture anchor fixation for lateral fabellotibial suture stabilisation produces measurably superior short-term functional outcomes compared with the traditional bone tunnel technique in small breed dogs. At 8 weeks, suture anchor dogs achieved a mean stifle range of motion of 128.4°, compared with 121.2° for bone tunnel dogs, and a peak vertical force of 72.3% of body weight versus 65.1% differences that reached statistical significance and are large enough to be clinically meaningful in a population where even modest lameness has a disproportionate impact on quality of life given the high exercise expectations of toy and small breed owners. The evidence supporting this conclusion includes not only the primary functional measures but also the lameness grade data (86.4% of SA dogs scored ≤ 1 at 8 weeks versus 66.7% of BT dogs) and the surgical time reduction (38.2 vs 52.7 minutes). The absence of tibial fractures in the SA group compared with one fracture in the BT group is

consistent with the biomechanical rationale that avoiding a transosseous tunnel reduces the risk of bone failure in small-diameter tibiae, although the sample size precludes a definitive conclusion on this endpoint. The clinical implication is that suture anchor LFTS should be considered the preferred extracapsular technique for dogs weighing less than 15 kg when the implant is available. The benefit appears greatest in the toy category (< 5 kg), where the PVF advantage of the suture anchor was approximately 10 percentage points a margin that likely reflects the disproportionately high mechanical risk of tunnel placement in very small bones. For practices that do not stock suture anchors, the bone tunnel technique remains an acceptable alternative, as its outcomes are adequate in the majority of cases. Several limitations qualify these findings. The follow-up period of 8 weeks captures the acute rehabilitation phase but not the long-term outcome. Late complications suture loosening, anchor migration, progressive osteoarthritis may emerge at 6 to 12 months and could alter the benefit profile. The trial was conducted by a single experienced surgeon, and the relative advantage of the suture anchor may be smaller in less experienced hands, where the tactile feedback required for correct anchor insertion could introduce additional variables. Additionally, the absence of blinding of the surgeon to group allocation introduces a potential performance bias, although the primary outcomes (goniometry and force-plate analysis) were assessed by blinded evaluators. Future work should extend the follow-up to 12 months to capture long-term outcomes, compare suture anchor LFTS against TPLO in the 10-15 kg weight range where both procedures are viable, and evaluate whether newer knotless anchor designs further simplify the procedure and improve fixation strength. A multi-centre trial with multiple surgeons would also help determine whether the advantages observed in this single-centre investigation are generalisable. In summary, for the population of small breed dogs presenting with CCL rupture a substantial caseload in companion animal practice worldwide suture anchor lateral fabellotibial suture stabilisation offers a technically simpler, faster, and functionally superior alternative to the bone tunnel technique, meriting adoption as the first-line extracapsular method when the implant is accessible.

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Collaborators

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Technical staff

Ms. Ayako Ishikawa coordinated patient scheduling and follow-up appointments. Mr. Takeshi Ogawa maintained the force-plate equipment and processed gait analysis data.

Data and resource providers

Arthrex VetSystems (Japan Division) provided the suture anchors at a reduced cost for research purposes. The Tokyo University of Animal Medicine Teaching Hospital supplied the force-plate laboratory and surgical facilities.

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