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Dome trochleoplasty for correction of patella alta and patella luxation in dogs > 20 kg

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OBJECTIVE
To describe the dome trochleoplasty procedure and report the short-term outcomes and complications associated with a novel technique to correct patellar luxation and patella alta.

ANIMALS
13 dogs (16 stifle joints) diagnosed with medial patellar luxation with concurrent patella alta in dogs > 20 kg.

CLINICAL PRESENTATION
Medical records of dogs weighing > 20 kg that underwent a dome trochleoplasty for correction of a medial luxating patella were prospectively evaluated. The procedure described involves an osteotomy of the femoral trochlea, which is then translated and/or rotated to correct patellar luxation. Clinical results were assessed using subjective lameness scoring, radiographic evaluation, and the Canine Brief Pain Inventory (CBPI) tool.

RESULTS
16 stifle joints were included in this study. The overall complication rate was 50%. Major complications occurred in 43.8% of stifle joints due to pin migration and recurrent luxation of the patella. One dog experienced a catastrophic complication 4 months postoperatively. Uncomplicated osteotomy healing was present in 94% of dogs. The median initial lameness score was 2 (mean, 1.81; range, 0 to 4) and at the final recheck was 0 (mean, 0.31; range, 0 to 2). The CBPI scores were available for 50% of stifle joints. The median initial CBPI score was 45.5 (mean, 48.8; range, 32 to 74) and at the final recheck was 17.5 (mean, 20.5; range, 0 to 43).

CLINICAL RELEVANCE
The dome trochleoplasty procedure offers an alternative technique for surgical correction of patellar luxation secondary to patella alta in large-breed dogs, but due to its higher complication and reluxation rates, it should be used cautiously and probably in combination with other corrective procedures, such as tibial tuberosity transposition, soft tissue imbrication, and/or soft tissue release rather than as a stand-alone procedure.

Keywords: patella alta, osteotomy, patella luxation, stifle joint, trochleoplasty

Patellar luxation is a commonly diagnosed orthopedic condition in dogs.[1] Dogs can present with varying signs ranging from mild instability of the patella within the trochlear groove with no clinical signs to constant luxation with skeletal deformity, gait abnormalities, and pain. This condition can also be accompanied by proximal displacement of the patella in the trochlear groove, known as patella alta, which may be associated with development of medial patellar luxation (MPL).[2]

Higher grades of patellar luxation are associated with greater anatomical abnormality and severity of lameness in large-breed dogs.[3] In cases of high-grade luxation, severe skeletal deformation and lameness can occur, and surgical treatment is warranted. The goal of corrective surgery is the realignment of the stifle extensor apparatus using both soft tissue and/or bone reconstructive techniques, including various types of trochleoplasty techniques to deepen the trochlear groove.[4–6] While deepening the trochlear groove would allow the normally located patella to sit in a deeper groove, dogs with patella alta have a patella that sits proximal to the femoral trochlea and can luxate due to the absence of the trochlear ridges limiting medial or lateral displacement.

Reported complications following surgical correction of MPL include delayed union of osteotomy

sites, fixation failure, recurrence of patellar luxation, and lameness, with complication rates of 18.5% to 37%.[3,6–9] In comparison with small-breed dogs, large-breed dogs can pose greater surgical challenges, as they have increased risk of postoperative complications and may require more extensive combinations of corrective procedures.[3]

The objectives of this study were to describe the dome trochleoplasty procedure and to report short-term outcomes and complications associated with a novel surgical technique to correct MPL secondary to patellar alta in larger-breed dogs. We hypothesized that the procedure would have a favorable outcome in correcting patellar luxation secondary to patella alta with minimal major complications compared with previous reports using other techniques.

Methods

Client-owned large-breed dogs weighing 20 kg or more were prospectively enrolled in this study based on a history of lameness and clinical diagnosis of patellar luxation secondary to patella alta via orthopedic and physical examinations and standard mediolateral and craniocaudal radiographic projections. Patella alta was diagnosed using a patellar ligament length-to-patellar length ratio of > 1.97 as previously described.[2] All owners were informed of this novel technique and were required to read and sign an informed consent agreement for dogs enrolled in the study. The breed, sex, neuter status, age, and body weight of each dog was recorded. Dogs were excluded from the study if they had concurrent orthopedic and/or neurologic disease at the time of initial diagnosis. The aim was to perform the procedure on a total of 20 stifle joints before closing enrollment; 4 stifle joints were excluded due to lack of patella alta as the cause for MPL.

To determine feasibility of the technique before use in clinical patients, the dome trochleoplasty procedure was first performed on canine saw bones. Following successful application of the technique to saw bones, it was performed on canine cadavers before being offered to client-owned dogs. Each dog was anesthetized using various balanced anesthetic protocols, was aseptically prepared for surgery, and received either an epidural or femoral-sciatic nerve block using 0.25% bupivacaine. A standard lateral approach to the stifle was performed[10] followed by visual evaluation of the stifle joint, femoral trochlea conformation, and position of the patella. A biradial saw blade was sized to ensure that the entire femoral trochlea, including the trochlear ridges, was excised parallel to the long axis of the femur. The osteotomy was started just proximal to the origin of the long digital extensor tendon into the distal femur and continued proximally up the cranial aspect of the femur until the trochlea was removed **(Figure 1)**.

The trochlea was then translated proximally until 75% of the patella sat within the trochlear groove to correct patella alta **(Figure 2)**. Additionally, the trochlea could be translated medially or laterally or rotated 180° to ensure sufficient medial or lateral trochlear wall height to prevent patellar luxation if necessary **(Figure 3)**.

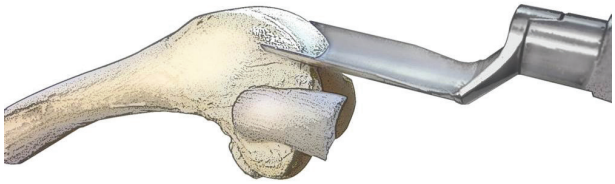

Figure 1—Osteotomy proximal to the origin of the long digital extensor tendon to remove trochlea.

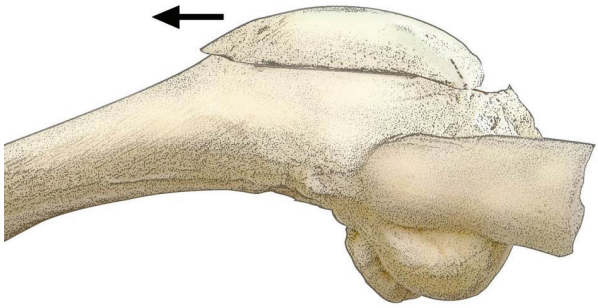

Figure 2—Translation of the trochlea proximally to correct patella alta.

The trochlea was secured in its new position using 2 divergent Kirschner wires (0.045 to 0.094 inches) placed just lateral to the trochlear ridges in a cranial-to-caudal direction **(Figure 4)** and advanced until they engaged the caudal femoral cortex. The Kirschner wires were then cut and countersunk below the articular cartilage. Each dog received standard protocol pain management, consisting of a single injection of carprofen (2.2 mg/kg, SC) postoperatively and hydromorphone (0.2 mg/kg, IV, q 6 h) or methadone (0.2 mg/kg, IV, q 6 h) for 24 hours. Dogs were monitored in the hospital for 24 hours postoperatively until discharge. Home care included cage rest, leash walking exercise for 8 weeks, and pain management consisting of tramadol (5 mg/kg, PO, q 12 h) for 10 days and carprofen (2.2 mg/kg, PO, q 12 h) for 30 days.

Postoperative clinical results were assessed using subjective lameness scoring, radiographic healing, and the Canine Brief Pain Inventory (CBPI) tool.

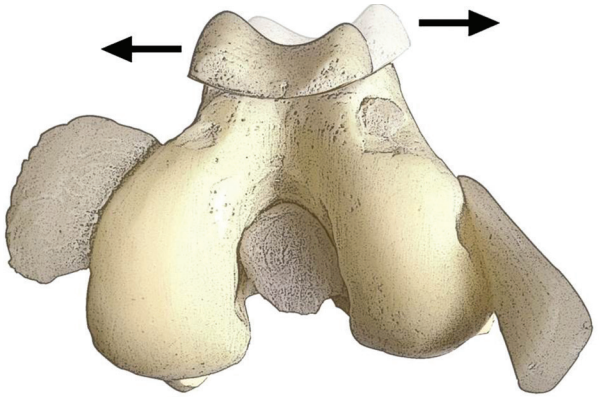

Figure 3—Translation of the trochlea medially or laterally to correct patellar luxation.

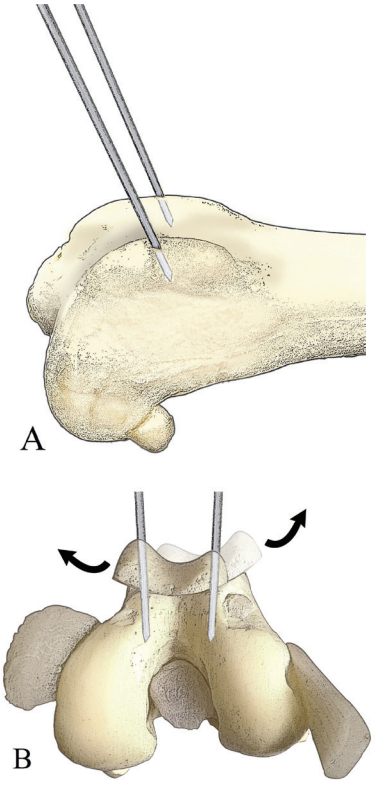

Figure 4—Kirschner wire placement securing the trochlear segment in its new position. A—Cranial-to-caudal pin placement. B—Lateral pin placement.

Catastrophic, major, and minor complications were recorded; catastrophic complications were defined as those leading to permanent unacceptable function, major complications were defined as those requiring additional surgical intervention, and minor complications were defined as those that were medically managed or resolved without therapy.

Orthopedic examinations were performed and lameness scores were assigned by the attending surgeon using a modified lameness scale of 0 to 5 (grade 0 = no lameness, 1 = intermittent weight bearing, 2 = consistent weight-bearing lameness, 3 = intermittent non–weight-bearing lameness, 4 = non–weight-bearing lameness, 5 = nonambulatory) before surgery, at 2 weeks postoperatively, and at the final recheck.[11] Radiographs were taken immediately postoperatively to ensure proper placement of implants and at 8 weeks postoperatively to assess bone healing and identify any complications; the osteotomy was considered healed when the osteotomy line was no longer visible and callus formation was present. Owners were asked to fill out the CBPI survey tool before surgery, at 2 weeks postoperatively, and at the final 8-week recheck examination.[12]

Data were analyzed using IBM SPSS Statistics for Windows, version 28 (IBM Corp). For each surgery, the median lameness score preoperatively was compared with the median lameness score 2 weeks postoperatively as well as the median lameness score at a final follow-up. Additionally, for each surgery, the median pain levels preoperatively were compared with median pain levels 2 weeks postoperatively and during a final follow-up. The nonparametric related-samples Wilcoxon signed rank test (2 tailed) was used to make the comparisons, and the significance value for all analyses was set at $\alpha = 0.05$.

Results

A total of 16 stifle joints (13 dogs) were included in the current study. All stifle joints were diagnosed with MPL with concurrent patella alta. The median patellar ligament length-to-patellar length ratio was 2.05 (mean, 2.1; range, 2.0 to 2.3). The left stifle was affected in 9 dogs (56.3%), and 7 dogs (43.8%) had the right stifle affected. Two stifle joints (12.5%) were diagnosed as grade 2 MPL, and 14 (87.5%) stifle joints were diagnosed as grade 3 MPL. Of the dogs included in the study, 43.8% were spayed females and 37.5% were neutered males. Ages ranged from 1 to 3 years old at the time of surgery (median, 1; mean, 1.37 years). The median body weight was 27.5 kg (mean, 30.1 kg; range, 20 to 65 kg).

Following arthrotomy, all dogs were found to have intact cranial and caudal cruciate ligaments and intact medial and lateral menisci. On evaluation of the femoral trochlea, 8 of the 16 stifles (50%) showed wearing at the proximal aspect of the medial trochlear ridge. Following the trochlear osteotomy, the trochlear segment was translated proximally in all 16 stifle joints. Additionally, the trochlear segment was translated medially in 4 stifle joints (25%), rotated 180° and translated medially in 5 stifle joints (31.3%), and rotated 180° alone in 1 stifle, and no rotation or medial translation occurred in 6 stifle joints (37.5%). The 6 stifle joints that did not have a rotation or medial or lateral translation of the osteotomized segment required a proximal advancement of the segment only. All stifle joints had proximal translation of the osteotomized segment. Concurrently performed procedures were tibial tuberosity transposition in 5 stifle joints and lateral fascial imbrication in all 16 stifle joints. No dogs in this study were identified as having femoral varus. If femoral varus was present, the dome trochleoplasty would not have been used, and a patient would have been treated with a distal femoral osteotomy instead.

Eight of 16 stifle joints (50%) had reported complications, which were diagnosed 42 to 224 days postoperatively (mean, 101.7 days). Major complications occurred in 7 stifle joints (43.8%) due to pin migration with subsequent removal (n = 4) and reluxation (3). The course of treatment for the 4 stifle joints in which pin migration occurred included pin removal under sedation followed by empirical treatment of cephalexin (22 mg/kg, PO, q 12 h) for 7 days. Of the 9 remaining stifle joints where the Kirshner wires remained in place, 8 of the osteotomized segments went on to heal without complication. One dog experienced a catastrophic complication 4 months postoperatively in which the dog had progressive, severe bone resorption of the osteotomized trochlear ridge noted on radiographs **(Figure 5)**. The dog was subsequently treated with a patellar groove replacement as previously described[13] and recovered.

Lameness scores were available for all stifle joints in this study, with a median final recheck time

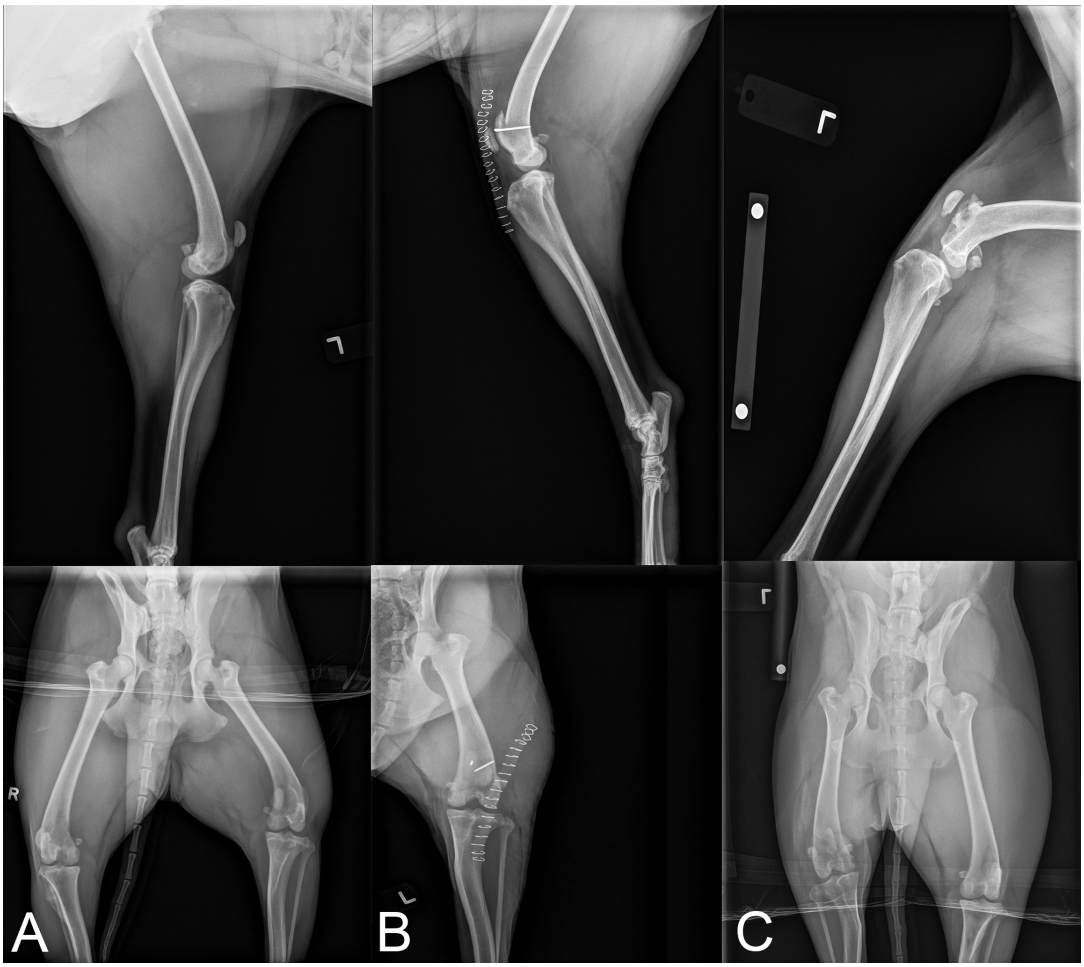

Figure 5—Mediolateral and craniocaudal radiographs taken of the left stifle joint preoperatively (A), immediately postoperatively (B), and 4 months postoperatively (C) demonstrating trochlear segment resorption follow dome trochleoplasty in the patient suffering a catastrophic complication. This patient went on to have a patellar groove replacement and recovered without further complications.

of 87.5 days (mean, 101.7 days; range, 42 to 224 days). The median initial, 2-week, and final recheck lameness scores were 2 (mean, 1.81 days; range, 0 to 4 days), 2 (mean, 2.63 days; range, 1 to 4 days), and 0 (mean, 0.31 days; range, 0 to 2 days). When comparing preoperative lameness scores to lameness scores taken 2 weeks postoperatively, there were 9 instances of lameness scores increasing, 5 instances of lameness scores remaining unchanged, and 2 instances of lameness scores decreasing. When comparing preoperative lameness scores to those taken during a final follow-up, there were 0 instances of lameness scores increasing, 2 instances of lameness scores remaining unchanged, and 14 instances of lameness scores decreasing.

Wilcoxon signed rank tests revealed that the median difference in lameness scores from preoperative levels to postoperative levels was significant. Specifically, lameness scores 2 weeks postoperatively (mean, 1.81; median, 2; SD, 1.22) were higher than preoperative lameness scores (mean, 2.62; median, 2; SD, 1.09; $P = .046$), but lameness scores at the final follow-up were significantly lower (mean, 0.31; median, 0; SD, 0.60) than preoperative levels ($P < .001$).

Immediate postoperative radiographs showed that proper implant placement was present in all dogs and that uncomplicated osteotomy healing was present in 15 of the 16 (94%) stifle joints at 8-week recheck radiographs. The CBPI scores were available for 8 of the 16 stifle joints (50%) with a median final recheck time of 112 days (mean, 112.8; range, 42 to 224 days). The initial 2-week and final mean CBPI scores were 45.5 (mean, 48.9; range, 32 to 74), 48 (mean, 47.4; range, 33 to 67), and 17.5 (mean, 20.5; range, 0 to 43). When comparing preoperative pain levels to pain levels taken 2 weeks postoperatively, there were 3 instances of pain levels increasing, 0 instances of pain levels remaining unchanged, and 5 instances of pain levels decreasing. When comparing preoperative pain levels to those taken during the final follow-up, there were no instances of pain levels increasing, no instances of pain levels remaining unchanged, and 8 instances of pain levels decreasing.

Wilcoxon signed rank tests revealed that pain scores were not different between preoperative levels (mean, 48.88; median, 45.50; SD, 12.90) and those recorded 2 weeks postoperatively (mean, 47.38; median, 48.00; SD, 12.32; $P = .48$), but pain levels during the final follow-up were significantly lower (mean, 20.50; median, 17.50; SD, 16.36) than they were preoperatively ($P = .01$.)

Discussion

The results of this study showed that the dome trochleoplasty procedure can be effective for cor-

recting patellar luxation associated with patella alta in dogs weighing greater than 20 kg, demonstrated by the improved median lameness and CBPI survey scores during the study period. However, for reliable results, the procedure should be performed in conjunction with other corrective procedures, such as tibial tuberosity transposition, soft tissue imbrication, and/or soft tissue release to minimize the risk of reluxation, and surgeons should consider that implant removal may also be required following bone healing.

The advantages of the procedure are its simplicity; its versatility in correcting a variety of patellar abnormalities, including patella alta; and the preservation of the entire articular cartilage surface area. A biradial saw blade was used to allow for the osteotomized segment to move proximally to correct patella alta but also to allow for medial or lateral rotation to increase the medial or lateral trochlear ridge height in cases of trochlear hypoplasia, which can be seen in many cases of patella luxation. The size of saw blade was chosen at the discretion of each surgeon to allow for an osteotomy of the entire femoral trochlea. In cases of MPL, hypoplasia of the medial trochlear ridge allows for unimpeded luxation over the shorter trochlear ridge. The dome trochleoplasty allows for either rotation of the segment medially to increase the medial trochlear ridge height or to rotate the segment 180° to use the lateral trochlear ridge to achieve appropriate medial stability. While there would be concern that decreasing the lateral trochlear ridge height would predispose the dogs to lateral patella luxation, this was not seen in our study population. While distal tibial tuberosity transposition and tibial tuberosity advancement do exist to correct patella alta, they do not allow for the simultaneous correction of multiple abnormalities associated with patella luxation.[14,15] The dome trochleoplasty technique can correct the issues with trochlear depth and malalignment of the quadriceps mechanism contributing to patella luxation and patella alta pathology simultaneously, potentially decreasing surgery and anesthesia time. Additionally soft tissue imbrication or releasing incisions may also be required to further prevent relaxation, but these can be done as part of incision closure and should not significantly increase surgery or anesthesia times. Further study is warranted using objective assessment measures, such as force plate gait analysis, and assessment of long-term outcomes, which is beyond the scope of this study.

The overall complication rate for the dome trochleoplasty procedure was 50%, which was significantly higher compared with previously reported patellar luxation procedures.[3,6–9] Major complications occurred in 43.8% of stifle joints (7/16 stifle joints), and catastrophic complications occurred in 1 stifle. Of the 7 stifle joints with major complications, 4 were due to pin migration from the dome trochleoplasty site, and the associated lameness resolved after pin removal. While considered a major complication, pin removal is a routine, straightforward procedure and can often be performed under sedation rather than general anesthesia. To limit pin migration, the use of threaded Kirschner wires or bioabsorbable pins could be employed, but additional studies would be necessary to evaluate the efficacy of these implants in preventing such migration. One dog had a catastrophic complication at 16 weeks postoperatively and was treated with a patellar groove replacement. In that case, it was suspected that vigorous activity early in the postoperative period may have led to disruption of the osteotomy blood supply and healing that resulted in significant, progressive bone resorption. This complication reinforced the directive for postoperative convalescence and activity restriction. Alternatively, excessive heating of the bone could have occurred during the osteotomy, leading to thermal injury and necrosis of the bone. Thermal injury can be mitigated by lavage during the osteotomy to cool the tissues.

Recurrence of patellar luxation postoperatively occurred in 19% of stifle joints (3/16 stifle joints) and required a second surgery to achieve proper reduction. Our reported reluxation rate was significantly higher than recent reports[8,9] of 6% to 6.4% involving small- to large-breed dogs. In each of these 3 cases, only the dome trochleoplasty was performed to correct the patellar luxation and patella alta. Each case of recurrent reluxation was treated with tibial tuberosity transposition, medial retinacular release, and lateral imbrication, which led to correction of the luxation. A 2007 study by Arthurs et al[16] found that dogs > 20 kg had a significantly higher risk for complications and reluxation but also found that dogs undergoing both trochleoplasty and tibial tuberosity transposition were less likely to encounter complications and reluxation. Given the findings of that study and our results, we would recommend that soft tissue procedures, such as soft tissue imbrication and soft tissue release, and tibial tuberosity transposition be performed in addition to the dome trochleoplasty, especially in dogs with higher-grade patellar luxation, to minimize the risk of recurrent luxation.

While simple to perform, the dome trochleoplasty procedure does have some limitations. First, the surgeon must ensure that the entire trochlea is excised with enough bone to prevent fracture of the exposed trochlear ridge. Second, there is the need for a biradial saw blade and specialized training to use this equipment. Finally, given that there are no set measurement protocols, the outcome of this procedure is dependent on the surgeon's ability to judge appropriate positioning of the resected trochlear segment. Further research may produce such necessary measurement protocols. The major limitations to the current study include a small sample size and the large percentage of patients lost to follow-up. Additionally, the subjective nature of the postoperative outcome evaluation by owners and veterinarians may lead to overestimation of clinical effect. The follow-up period was also relatively brief, with maximum follow-up being 6 months postoperatively. Long-term follow-up would be valuable for evaluating patient outcome and progression of osteoarthritis.

The findings of this study led us to reject our hypothesis and instead to suggest that when used

alone, the dome trochleoplasty would not be recommended for surgical correction of patellar luxation and patella alta in large-breed dogs due to its higher complication and reluxation rates than those of previously reported procedures. Dome trochleoplasty may possibly be used, cautiously, in combination with other corrective procedures rather than as a stand-alone procedure. While the major complication rate was higher than in previous studies, the majority of complications were due to pin migration. Subsequent removal, which is a simple procedure and can be done under sedation, resulted in favorable outcomes. Further studies are warranted to investigate strategies to minimize pin migration, to investigate the potential use of dome trochleoplasty in smaller-breed dogs, and to better assess long-term clinical outcomes.

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Dr. Ericksen acquired data and drafted the manuscript. Dr. Stobie was involved in study design, performed the procedure, and critically revised the manuscript. Dr. Culbert performed the procedure and critically revised the manuscript. Dr. Valenzano critically revised the manuscript. Dr. Bogart performed statistical analysis. All authors approved the submitted manuscript.

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References

1. Di Dona F, Della Valle G, Fatone G. Patellar luxation in dogs. *Vet Med (Auckl)*. 2018;9:23-32. doi:10.2147/VMRR.S142545
2. Johnson AL, Broaddus KD, Hauptman JG, Marsh S, Monsere J, Sepulveda G. Vertical patellar position in large-breed dogs with clinically normal stifles and large-breed dogs with medial patellar luxation. *Vet Surg*. 2006;35(1):78-81. doi:10.1111/j.1532-950X.2005.00115.x
3. Gibbons SE, Macias C, Tonzing MA, Pinchbeck GL, McKee WM. Patellar luxation in 70 large breed dogs. *J Small Anim Pract*. 2006;47(1):3-9. doi:10.1111/j.1748-5827.2006.00004.x
4. Kowaleski MP, Boudrieau RJ, Pozzi A. Stifle joint. In: Tobias KM, Johnston SA, eds. *Veterinary Surgery Small Animal.* Vol 1. 2nd ed. Elsevier; 2018:1146–1147.
5. Slocum B, Slocum DB, Devine T, Boone E. Wedge recession for treatment of recurrent luxation of the patella: a preliminary report. *Clin Orthop Relat Res*. 1982;164:48–53. doi:10.1097/00003086-198204000-00012
6. Johnson AL, Probst CW, Decamp CE, et al. Comparison of trochlear block recession and trochlear wedge recession for canine patellar luxation using a cadaver model. *Vet Surg*. 2001;30(2):140–150. doi:10.1053/jvet.2001.21391
7. Willauer CC, Vasseur PB. Clinical results of surgical correction of medial luxation of the patella in dogs. *Vet Surg*. 1987;16(1):31–36. doi:10.1111/j.1532-950X.1987.tb00910.x
8. Rossanese M, German AJ, Comerford E, Pettitt R, Tomlinson A, de Vicente F. Complications following surgical correction of medial patellar luxation in small-to-medium-size dogs. *Vet Comp Orthop Traumatol*. 2019;32(4):332–340. doi:10.1055/s-0039-1683872
9. Cashmore RG, Havlicek M, Perkins NR, et al. Major complications and risk factors associated with surgical correction of congenital medial patellar luxation in 124 dogs. *Vet Comp Orthop Traumatol*. 2014;27(4):263–270. doi:10.3415/VCOT-13-08-0100
10. Piermattei DL, Johnson KA, Giddings FD. Approach to the stifle joint through a lateral incision. In: *Piermattei's Atlas of Surgical Approaches to the Bones and Joints of the Dog and Cat.* 5th ed. Elsevier; 2014:392–395.
11. Brønniche Møller Nielsen M, Pedersen T, Mouritzen A, et al. Kinetic gait analysis in healthy dogs and dogs with osteoarthritis: an evaluation of precision and overlap performance of a pressure-sensitive walkway and the use of symmetry indices. *PLoS One*. 2020;15(12):e0243819. doi:10.1371/journal.pone.0243819
12. Brown DC, Boston RC, Coyne JC, Farrar JT. Ability of the canine brief pain inventory to detect response to treatment in dogs with osteoarthritis. *J Am Vet Med Assoc*. 2008;233(8):1278–1283. doi:10.2460/javma.233.8.1278
13. Dokic Z, Lorinson D, Weigel JP, Vezzoni A. Patellar groove replacement in patellar luxation with severe femoro-patellar osteoarthritis. *Vet Comp Orthop Traumatol*. 2015;28(2):124–130. doi:10.3415/VCOT-14-07-0106
14. Segal U, Or M, Shani J. Latero-distal transposition of the tibial crest in cases of medial patellar luxation with patella alta. *Vet Comp Orthop Traumatol*. 2012;25(4):281–285. doi:10.3415/VCOT-11-07-0108
15. Pugliese LC, Pike FS, Aiken SW. Distal tibial tuberosity translation using TTA implants for the treatment of patella alta in large breed dogs. Surgical technique and clinical outcome. *Vet Comp Orthop Traumatol*. 2015;28(4):274–281. doi:10.3415/VCOT-14-05-0075
16. Arthurs GI, Langley-Hobbs SJ. Patellar luxation as a complication of surgical intervention for the management of cranial cruciate ligament rupture in dogs. A retrospective study of 32 cases. *Vet Comp Orthop Traumatol*. 2007;20(3):204–210. doi:10.1160/VCOT-06-10-0074