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Treatment and Potential Co-occurrence of Hip Subluxation, Patella Alta, and Medial Patellar Luxation in a Canine: Case Report

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Cite this article as: Leal, L. M., Silva, C. H., Campos Júnior, P. A., Pavilak, G. A., Gonçalves, M. D., Romani, I., Sasahara, T. H. C., & Moraes, P. C. (2024). Treatment and potential co-occurrence of hip subluxation, patella alta, and medial patellar luxation in a canine: Case report. *Acta Veterinaria Eurasia*, 50(3), 250-254.

Abstract

In light of the potential correlation between hip alterations and the development of patellar luxation, as well as the challenge in selecting the ideal surgical technique for each patient, the aim is to report the treatment of a 17 kg, 1-year-old, female dog of undefined breed, presenting with grade III patellar luxation, patella alta, and hip subluxation. The patient experienced clinical improvement following the implementation of several surgical techniques. An ilio-trochanteric suture was employed to stabilize the hip joint. Due to significant contracture of the rectus femoris muscle observed during the coxal approach, which impeded proper patellar positioning, a rectus femoris tenotomy was also performed. This intervention resulted in an immediate reduction in the degree of patellar luxation from III to II. Additionally, modified trochleoplasty was performed to deepen the groove. We concluded that the ilio-trochanteric suture, in conjunction with rectus femoris tenotomy, contributed to partial alignment of the quadriceps femoris muscles, enhancing stability of the hip joint and resulting in a one-degree reduction in patellar luxation. Modified trochleoplasty stabilized the patella alta. This study reinforces the correlation between hip joint positioning and the probable etiology of patellar dislocation.

Keywords: Claudication, dislocation, dysplasia, ilio-trochanteric, tenotomy

Introduction

Patellar luxation is a common orthopedic condition in dogs and cats. It is characterized by medial or lateral displacement of the patella, leading to lameness in animals. The pathophysiology of the disease is not yet fully understood, but it is believed that the positioning of the hip joint plays a role in the pathogenesis of the condition (Da Silva et al., 2022; Fossum, 2014). Traumatic causes have been described in the literature, but most cases are thought to be congenital and hereditary (Padilha Filho et al., 2005).

Medial patellar luxation is the most common form of the condition. It is most common in small breeds, but is not uncommon in large breeds. Lateral patellar luxation is rare and is most commonly seen in large dogs. Patellar luxation is classified into grades: I, II, III, and IV (Decamp et al., 2016; Engdahl et al., 2023; Fossum, 2014).

The diagnosis of patellar luxation is clinical, but imaging tests help to assess the deformities of the femur and tibia, which are decisive for choosing the best surgical technique. Trochleoplasty, lateral imbrication, medial desmotomy, osteotomy of the femur and tibia, transposition of the tibial crest, transposition of the rectus femoris, anti-rotational suture, and fabelopatellar suture are described as techniques for correcting patellar dislocation (Isaka, 2022; Moens, 2022; Petazzoni, 2015).

Hip subluxation is common in young dogs with hip dysplasia due to the joint laxity found in most patients. Hip dysplasia is a common condition in which there is instability between the pelvis and the femur. Its etiopathogenesis is not fully understood, but it is suggested that hip subluxation, due to hip laxity, potentiates acetabular dragging, further increasing the degree of bone displacement (Degregori, 2018; Fossum, 2014).

The therapies used to treat hip subluxation can be conservative or surgical. Various techniques have been described to treat hip subluxation in patients with hip dysplasia, such as pubic symphysiodesis, pectinectomy, double or triple osteotomy of the pelvis, amputation of the head and neck of the femur, and total hip prosthesis (Tôrres et al., 2005; Tudury, 2012).

Considering the potential concurrent between hip abnormalities and the development of patellar luxation, as well as the challenge in selecting the optimal surgical technique for individual cases, it was deemed relevant to detail the treatment and diagnosis of a one-year-old female dog presenting with grade III patellar luxation,

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Received: February 8, 2024 • **Revision requested:** April 18, 2024 • **Last revision received:** May 2, 2024 • **Accepted:** May 23, 2024 • **Publication Date:** July 31, 2024 • DOI: 10.5152/actavet.2024.24011

Available online at actavet.org

proximal displacement of the patella in the trochlear groove (patella alta), and hip subluxation. The patient exhibited clinical improvement following a combination of surgical interventions, including ilio-trochanteric suture placement, tenotomy of the rectus femoris muscle, transposition of the tibial tuberosity, modified abrasion trochleoplasty, medial desmotomy, and lateral imbrication of the left pelvic limb.

Case Presentation

The patient was a 17 kg, 1-year-old, neutered female dog of undefined breed, with a history of intermittent non-weight-bearing lameness of the left pelvic limb since birth. Orthopedic examination revealed a grade III medial patellar luxation in the left pelvic limb, a grade I medial patellar luxation in the right pelvic limb, and hip subluxation by the Ortolani test. Radiographic examination confirmed the left hip subluxation, with no signs of hip dysplasia such as acetabular dragging and alterations to the femoral head and neck. The angular deformities of the femur and tibia were measured. An internal rotation of the proximal region of the left tibia and a slight varus formation in the distal region of the left femur were noted (Figures 1 and 2). The aLDFA (anatomical lateral distal femoral angle) of the left femur was 100º and the internal rotation of the proximal left tibia was 15º (Petazzoni, 2015). In addition, patella alta was noted in both limbs. L:P was measured using radiographs in the mediolateral position of the pelvic limbs (Johnson et al., 2006) The L:P (ratio of the length of the patellar ligament to the length of the patella) of the right pelvic limb was 1.98 and that of the left pelvic limb was 2.11.

The right pelvic limb exhibited no angular changes. Consequently, left hip stabilization and correction of the bone and soft tissue alterations contributing to the left medial patellar luxation were warranted. Preoperative tests, including a complete blood count, ALT (alanine aminotransferase), and creatinine, were conducted, all yielding results within normal limits. Subsequently, the patient was transferred to the surgical center, where the following procedures were sequentially performed: ilio-trochanteric suture, tenotomy of the rectus femoris muscle, lateral transposition of the tibial tuberosity, modified abrasion trochleoplasty, medial desmotomy (involving the release of the contracted medial retinaculum), and lateral

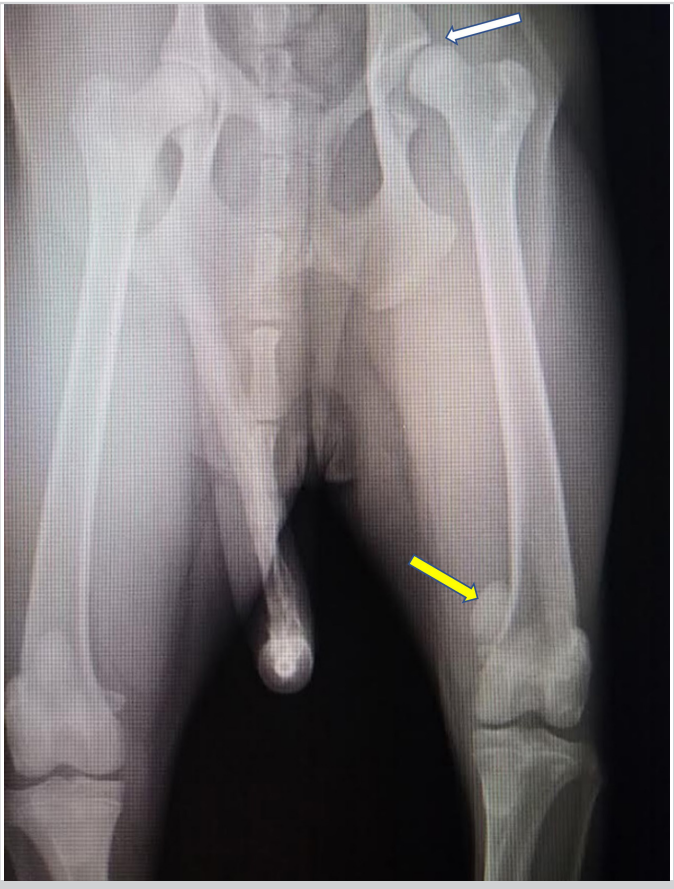

Figure 1.
Preoperative radiographic image of the left pelvic limb of a 1-year-old dog. Craniocaudal projection of the hip joint and femur. Left hip subluxation can be seen (white arrow), with no classic signs of hip dysplasia and slight varus deviation of the distal region of the femur with medial patellar luxation (yellow arrow).

Figure 2.
Preoperative radiographic image of the left pelvic limb of a 1-year-old dog. Craniocaudal projection of the left tibia. Internal rotation of the tibial crest and slight valgus formation of the proximal region of the tibia can be seen (red arrow).

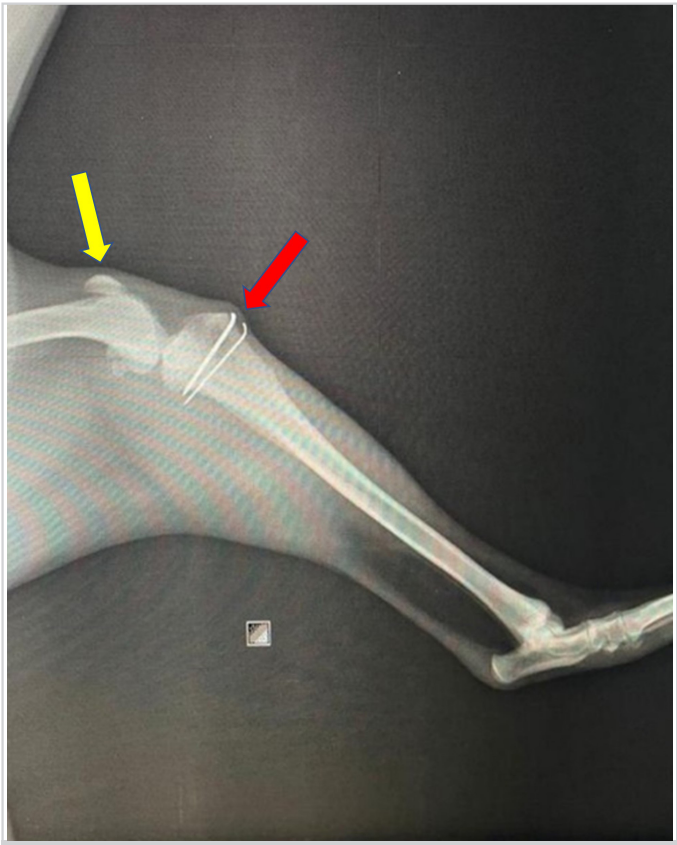

Figure 3.
Radiographic images of the left pelvic limb of a 1-year-old postoperative dog. Mediolateral projection. Pins fixing the transposition (red arrow) of the tibial tuberosity and the patella alta can be seen (yellow arrow).

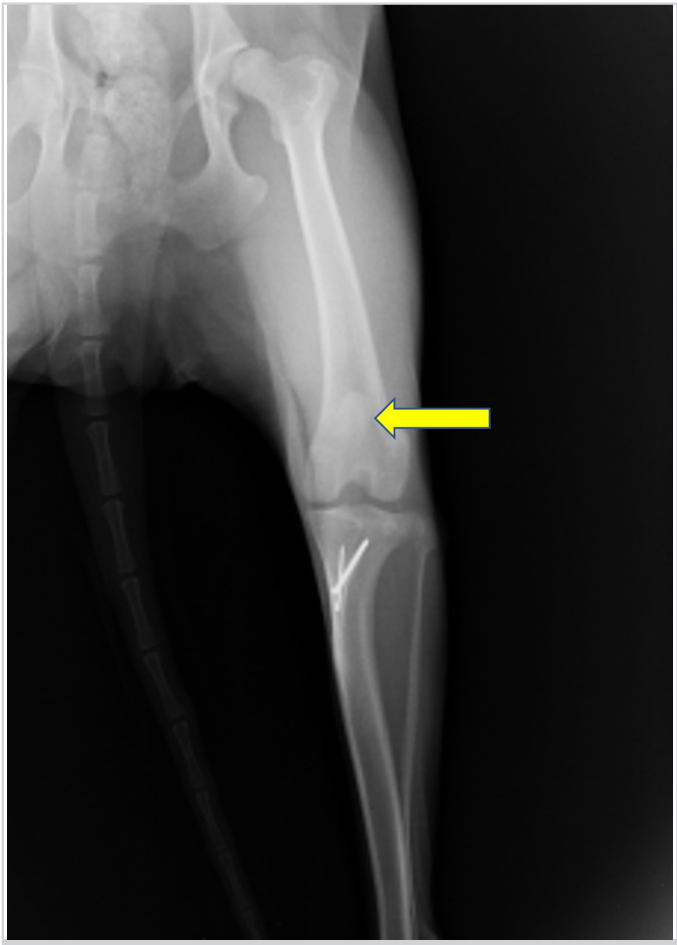

Figure 4.
Radiographic images of the left pelvic limb of a 1-year-old postoperative dog. Craniocaudal projection. The patella is visible in its anatomical position (yellow arrow).

imbrication of the left pelvic limb. Postoperative radiographs were obtained (see Figures 3 and 4).

The ilio-trochanteric suture was utilized for hip stabilization (Martini et al., 2001). Due to significant contracture of the rectus femoris muscle encountered during the coxal approach and its impact on patellar positioning, a tenotomy of the rectus femoris at its origin in the body of the ilium was also performed. The tenotomy procedure was carried out using the same surgical approach employed for the ilio-trochanteric suture. To execute the rectus femoris muscle tenotomy, a 5-cm-longitudinal skin incision was made in the lateral region of the coxofemoral joint, cranially to the greater trochanter. The gluteal and lata fasciae were incised, followed by retraction of the biceps femoris muscle caudally and the tensor fasciae latae muscle cranially. Subsequently, the tendon of origin of the rectus femoris muscle, located in the body of the ilium, was identified following dorsal displacement of the gluteal muscles with a Hohmann retractor. Tenotomy was performed using Metzembaum scissors along the arcuate line of the ilium. The tendon was left free, without any form of fixation. Closure of the lata and gluteal fascia was achieved through continuous suturing with 2-0 poliglecaprone 25. The subcutaneous tissue was then approached continuously with 3-0 poliglecaprone 25, and the skin was sutured using 3-0 nylon in a simple interrupted pattern.

Immediately following tendon rupture, a reduction in the degree of patellar luxation from grade III to grade II was observed. Subsequently, the remaining techniques to correct the patellar luxation were performed sequentially, utilizing the classic knee approach (Decamp et al., 2016; Moens, 2022; Petazzoni, 2015).

The procedure was successful, with no complications. Written consent was obtained from the animal owner. The following were prescribed for the postoperative period: Omeprazole (1 mg/kg, SID, VO) for 10 days; Cephalexin (30 mg/kg, BID, VO) for 10 days; Meloxicam (0.1 mg/kg, SID, VO) for 5 days; Tramadol (4 mg/kg, BID, VO) for 5 days; Dipyrone (25 mg/kg, BID, VO) for 5 days. Absolute rest for 30 days; cleaning of the wound with saline solution daily for 7 days and use of a protective collar until the sutures are removed.

Ten days post surgery, the patient returned for suture removal. The animal exhibited no lameness and was in good clinical condition. Symmetrical pelvic limbs with proper alignment of the bone axis during locomotion were observed. Subsequently, the patient was discharged. Three weeks later, the patient returned for radiographic follow-up, revealing a healed tibial crest osteotomy. At the 90-day

mark post surgery, the patient remained in good general condition, with aligned limbs and a stable hip.

The owner of the animal described authorized the performance of the aforementioned procedures, as well as allowing the use of his animal's data for possible scientific publication.

Discussion

While the exact etiopathogenesis of patellar dislocation remains incompletely understood, several authors have proposed a potential influence of hip joint positioning on the development of patellar disorders (Da Silva et al., 2022; Decamp et al., 2016; Denny & Butterworth, 2006). Common anatomical abnormalities observed in the hip include alterations in retroversion and inclination angles (varus or valgus) of the femoral neck and head. We hypothesize that such hip alterations may result in displacement of the quadriceps femoris muscle group due to the origin of the rectus femoris muscle in the ilium, subsequently leading to patellar luxation via its insertion into the patella (Leal, 2021). The consequences of a medially displaced patella may include lateral rotation and varus of the distal femur, a shallow trochlear groove with underdeveloped medial trochlear crest, dysplasia of the distal femoral epiphysis, rotation and lateral laxity of the femorotibial joint, medial valgus and rotation of the proximal tibia, medial deviation of the tibial tuberosity, external rotation of the tarsus, and reduced limb growth (Fujita & Kaneko, 2022; Moens, 2022; Petazzoni, 2015). In the present case, no angular changes were observed in the femoral head and neck, but the patient exhibited soft tissue laxity leading to hip joint instability, which we hypothesize to be responsible for the patellar dislocation in this patient. While there are alternative hypotheses suggesting that patellar luxation may also impact the position of the hip, we do not subscribe to this belief. This is primarily due to the significant number of hip stabilizing muscles present in dogs compared to the muscular stabilization of the patella, which is a sesamoid bone formed solely at the insertion tendon of the quadriceps femoris. The hip joint is directly influenced by various external and internal muscles that aid in stabilizing the joint, including the gluteal muscles, piriformis muscle, obturator muscles, gemelli muscles, quadratus femoris muscle, and articularis coxae muscle (Leal, 2021).

According to Petazzoni (2015), precise radiographic positioning is crucial for accurately measuring bone changes, as improper positioning can lead to false-positive limb deformities on radiographs. While the diagnosis of patellar luxation was primarily clinical, based on intermittent claudication without a history of trauma and patellar dislocation observed during orthopedic examination, radiographic evaluation was essential for formulating the surgical plan. It is imperative to isolate the femur and tibia so that each bone can be adequately positioned in the radiograph. In severe cases necessitating significant corrective osteotomies, special imaging techniques such as specific incidences, computed tomography (CT) scans, and three-dimensional prints are invaluable for surgical planning (Leite, 2022). However, in the case of the patient under consideration, the owner declined a CT scan due to cost constraints. Consequently, the assessment of bone changes relied solely on radiographs. Sedation and multiple images were required to achieve minimally satisfactory positioning.

Subluxation of the femoral head is a common occurrence in the clinical practice of dogs, often observed in young animals (Todhunter et al., 2003). The primary reported cause is laxity of the soft tissues adjacent to the joint, including the round ligament of the femoral head and laxity of the joint capsule associated with hip dysplasia (Fossum, 2014). Hip dysplasia is characterized by congenital alterations of the hip, leading to progressive degeneration of the acetabulum and femoral head and neck. Treatment approaches vary; conservative management is suitable for mild cases, whereas surgical intervention is recommended for cases unresponsive to medical treatment (Remedios et al., 1992). Given the absence of osteoarthritis, a shallow acetabulum, and favorable varus/valgus angulation of the femoral neck in this young animal, an ilio-trochanteric suture was performed to enhance joint stability. Although the ilio-trochanteric suture is typically indicated for patients with traumatic hip dislocation (Denny & Butterworth, 2006; Martini et al., 2001), no descriptions were found in the literature regarding its use for congenital subluxations. We hypothesize that this technique may offer temporary stabilization in young animals with hip soft tissue laxity, potentially preventing exacerbation of acetabular dragging due to femoral head subluxation during development. However, further studies are warranted to validate this hypothesis.

Due to the necessity of exposing the ilium for the ilio-trochanteric suture and the pronounced contraction of the rectus femoris muscle observed when the patella is dislocated during surgery, a tenotomy of the rectus femoris muscle was performed to alleviate medial traction of the patella. Remarkably, immediately following the tenotomy, during the intraoperative period, the degree of patellar dislocation decreased from grade III to grade II, even without any additional intervention in the knee region. Techniques involving the transposition of the rectus femoris muscle for adjunctive treatment of patellar dislocation have been described in the literature (Moens, 2022). However, in the present case, the tenotomy alone sufficed to achieve a favorable outcome for the patient.

Numerous techniques have been described for the treatment of patellar dislocation (Decamp et al., 2016; Denny & Butterworth, 2006; Fossum, 2014; Isaka, 2022; Moens, 2022; Petazzoni, 2015). In this patient, considering the identified alterations and as a complement to the initially performed rectus femoris tenotomy, trochleoplasty, lateral transposition of the tibial crest, medial desmotomy, and lateral imbrication were executed on the left pelvic limb.

By making an incision on the medial side of the proximal portion of the tibia, it is possible to transpose the tibial tuberosity. In this patient, the technique was performed because there was internal rotation of the tibial tuberosity. This technique requires an osteotomy, which separates the tibial crest from the tibial body, lateral displacement of the crest, and consequent fixation with orthopedic implants. The most common of which is with pins and steel wires forming a tension band (Denny & Butterworth, 2006; Fossum, 2014). However, due to the partial osteotomy of the tuberosity (Petazzoni, 2015), only two pins were used without the need for a steel wire tension band.

Medial desmotomy is the simple release of the medial retinaculum of the knee. The medial retinaculum retracts the patella, making it difficult to reposition it anatomically. Lateral imbrication, in turn, is characterized by overlapping the joint capsule laterally to the patella, so that there is controlled traction of the patella in a lateral direction (Decamp et al., 2016; Denny & Butterworth, 2006; Moens, 2022). Thus, knowing that there was contracture of the soft tissues

medially and distension of the joint capsule laterally due to the chronicity of the case, both techniques were performed on the patient in question.

A shallow or absent trochlear groove and underdeveloped trochlear crest are indicative of a patient in need of trochlear groove deepening (Denny & Butterworth, 2006). The technique was therefore carried out because the patient in this report also had a shallow sulcus. Several trochleoplasty techniques have been described: wedge, abrasion, block, and shield (Fossum, 2014; Decamp et al., 2016). For the patient in question, we opted for the modified abrasion technique, as the animal had a patella alta which made it difficult to use techniques that preserve the articular cartilage. According to Johnson et al. (2006), the patella is considered high when the L:P values are greater than 1.97 and in the left pelvic limb of the patient in question it was 2.11. The bone was scraped only in the proximal region of the trochlea, extending to the proximal region of the bone, creating a groove over the metaphysis of the femur. Patella alta is usually treated with wedge osteotomy of the tibia. However, the technique is more complex and the limb can be significantly shortened in the postoperative period (Campbell et al., 2016). Therefore, we opted only for modified abrasion trochleoplasty, which provided good functional return of the limb. A patella alta can predispose to medial patellar luxation (Moens, 2022).

The ilio-trochanteric suture combined with tenotomy of the rectus femoris muscle resulted in partial alignment of the quadriceps femoris muscles, thereby enhancing stability of the hip joint and achieving a one-degree reduction in patellar luxation. Modified trochleoplasty addressed the issue of patella alta. However, to effectively correct patellar dislocation, classic techniques such as imbrication, desmotomy, and tibial tuberosity transposition were necessary. This study underscores the correlation between hip joint positioning as a likely etiological factor for patellar dislocation.

The rapid recovery of the patient surpassed expectations, as it is typical to observe some degree of lameness in the immediate postoperative period (DiGiovanni et al., 2023). However, it is believed that the swift recovery was attributed to the young age of the patient and the absence of arthrosis, which is frequently observed in cases of hip dysplasia and patellar luxation (Decamp et al., 2016).

Informed Consent: Written consent was obtained from the animal owner.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – L.M.L.; Design – L.M.L.; Supervision – P.C.M.; Resources – P.A.C.J.; Materials – C.H.S.; Data Collection and/or Processing – C.H.S.; Analysis and/or Interpretation – L.M.L.; I.R.; Literature Search – M.D.G.; Writing Manuscript – L.M.L.; G.A.P.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: The authors declared that this study has received no financial support.

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