Bilateral Talocalcaneal and Talocalcaneocentral Luxation after a Road Traffic Accident in a Dog

Tomas Serrano-Crehuet[1] Jorge Espinel-Rupérez[1] Olga Amorós[2] Ronan A. Mullins[1]

[1] Section of Small Animal Clinical Studies, School of Veterinary Medicine, University College of Dublin, Belfield, Dublin, Ireland
[2] Section of Equine Clinical Studies, Diagnostic Imaging and Anaesthesia, School of Veterinary Medicine, University College Dublin, Dublin, Ireland

Address for correspondence Ronan Mullins, MVB DipECVS, Section of Small Animal Clinical Studies, University College of Dublin, Belfield, D04 W6F6, Dublin 4, Ireland (e-mail: ronan.mullins@ucd.ie).

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Abstract

A 4-year-old, 25 kg, male, castrated, crossbreed dog was referred after having been driven over by a trailer 3 days prior. On examination, the dog was unable to ambulate on the pelvic limbs. There was crepitus, soft tissue swelling and pain on manipulation of the tarsi, with bilateral rotational and suspected mild lateral instability. Radiographs identified bilateral talocalcaneal luxation with dorsal displacement of the head of talus and bilateral avulsion fracture of lateral malleolus. A dorsomedial approach to the tarsocrural joint was performed bilaterally and the dorsal luxation of the head of talus was reduced. A 3.5 mm positional cortical screw was placed on both sides from dorsomedial head of talus to plantarolateral distal calcaneus. A temporary calcaneotibial screw was also applied bilaterally. No complications were encountered apart from mild bandage-related dermatitis, and the dog made a complete recovery. No lameness was identified on subjective gait assessment at 14 weeks and 12 months postoperatively; however, mild-to-moderate osteoarthritis affecting the talocalcaneocentral and centrodistal joints was identified at 12 months postoperatively.

Keywords

- talocalcaneal luxation
- talocalcaneocentral luxation
- dorsal displacement of the head of the talus
- dog
- tarsus

Introduction

Tarsal injuries are common in dogs; however, injuries involving the talocalcaneal joint are uncommon.[1] Only six publications describe talocalcaneal luxation or subluxation in dogs, and all are case reports or small case series.[2–7] Talocalcaneal luxation is characterised by complete separation or displacement of the talus and calcaneus and involves rupture of both talocalcaneal ligaments.[1–3,5–7] The presence of mineralised fragments between the talus and calcaneus is occasionally reported and likely represents small avulsion fractures of these talocalcaneal ligaments.[3,5] With talocalcaneal luxation, concurrent luxation/subluxation of the talocalcaneocentral or calcaneoquartal joint, both of which comprise the proximal intertarsal joint, is typically present.[1–3,5,7] Concurrent talocalcaneocentral luxation can involve dorsal[1,3,5] or plantar[2] displacement of talar head, with or without calcaneoquartal subluxation.[2] Talocalcaneal luxation/subluxation in dogs is usually traumatic in origin, with road traffic accidents commonest.[2–7] Affected animals usually present with non-weight bearing lameness.[2,3,5–7] Abnormal orthopaedic examination findings include pain, swelling and crepitus on palpation of the affected tarsus[3,4,6]; varus angulation and internal rotation of the pes[2]; lateral distortion of the foot[7] and unspecified rotation of the foot.[6] Previously described treatment options for dogs with talocalcaneal luxation or subluxation include arthrodesis of the talocentral joint using a dynamic compression plate,[3] placement of a positional or lag talocalcaneal screw,[5–7] placement of a positional calcaneotalar screw[2] and external

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coaptation.[6] Reports describing clinical and/or radiographic outcomes of dogs with concurrent talocalcaneocentral luxation are limited.[2,3] Within such reports,[2,3,5] radiographic follow-up is limited to 2 months postoperatively. A primary surgical textbook recommends placement of a screw between the head of the talus and the base of the calcaneus; however, reports describing the long-term clinical and radiographic outcome of this method of repair are lacking.[1] The purpose of this report is to describe the surgical treatment of a dog with bilateral talocalcaneal and talocalcaneocentral luxation and report the long-term postoperative clinical and radiographic outcome.

Case Description

A 4-year-old, 25 kg, male, castrated, Collie cross was referred after having been driven over by a trailer 3 days prior. On examination at the primary veterinary clinic, a non-weight bearing right pelvic limb lameness and abnormal angulation of the distal limb were identified. Physical examination identified wounds over the right stifle and in between the second and third digits of the right pelvic limb, as well as severe abrasions affecting the caudal abdomen. Radiographs of the right tarsus revealed dorsal luxation of the talar head, and the dog was referred. The dog received intravenous (IV) fluid therapy, buprenorphine hydrochloride, meloxicam, gabapentin and amoxicillin clavulanic acid. The wounds were lavaged and closed primarily, the abrasions clipped and lavaged and radiographs of both pelvic limbs, pelvis and abdomen obtained. Radiographs of the pelvis and abdomen were unremarkable. The dog was subsequently referred for surgical management of the right tarsal injury.

At the time of presentation to our institution, the dog was receiving meloxicam and gabapentin. On examination, the dog was non-ambulatory. There was crepitus, soft tissue swelling and pain on manipulation, as well as rotational and suspected mild lateral instability of both tarsi. Mediolateral and dorsoplantar radiographs identified talocalcaneal luxation with dorsal luxation of the head of talus (talocalcaneocentral luxation), small mineral fragments between the talus and calcaneus and a small displaced mineral fragment distolateral to the lateral malleolus (►**Fig. 1**). Following attempts of closed reduction of talcalcaneocentral luxation bilaterally, varus and valgus stressed views with the tarsocrural joints in full extension did not identify any obvious lateral instability; however, re-luxation easily reoccurred with manipulation (►**Fig. 2**).

Both pelvic limbs were clipped and aseptically prepared for surgery. The dog received cefuroxime sodium (10 mg/kg IV) at induction and continued intraoperatively every 90 minutes. Intraoperative analgesia consisted of constant rate infusions of ketamine (0.3–0.6 mg/hg/hr) and fentanyl hydrochloride (3–8 µg/kg/hr). With the dog in dorsal recumbency, a dorsomedial approach to the right tarsocrural joint was performed, centred on the talus, from the medial malleolus to the base of metatarsal II. The medial collateral ligament was intact bilaterally. The luxation of the head of talus was identified and reduced bilaterally and a large point to point reduction forceps placed from dorsomedial head of talus to plantarolateral aspect of distal calcaneus. A 1.1-mm Kirschner wire and subsequently a 1.5-mm drill bit was inserted from dorsomedial head of talus to plantarolateral aspect of distal calcaneus. This was followed with a 2-mm and subsequently 2.5-mm drill bit and finally a 3.5-mm self-tapping cortical positional screw. Following placement of the talocalcaneal screw, no tarsocrural instability was detected. A 3.5-mm self-tapping cortical calcaneotibial screw was placed via a plantaromedial approach to proximal calcaneus for temporary immobilization of the tarsocrural joint. Both dorsomedial and plantaromedial incisions were routinely closed in three layers. The same procedure was performed on the contralateral side. Postoperative radiographs identified reduction in bilateral talocalcaneal and talocalcaneocentral luxation, with adequate implant placement (►**Fig. 3**).

A modified Robert Jones bandage was applied postoperatively and maintained for 5 weeks in total. Fentanyl (4 µg/kg/hr) and ketamine hydrochloride (5 µg/kg/min) constant rate infusions were administered overnight and gradually decreased and substituted for methadone hydrochloride (0.2 mg/kg IV q4hrs) in line with analgesia requirements. The dog was hospitalized for 7 days postoperatively for the management of the wounds and abrasions, provision of postoperative analgesia, and to provide assistance with ambulation in the early postoperative period. Meloxicam (0.1 mg/kg per os [PO] q24hrs), tramadol hydrochloride (4 mg/kg PO q12hrs) and paracetamol (10 mg/kg PO q12hrs) were administered for 14, 7, and 7 days postoperatively, respectively. Postoperative

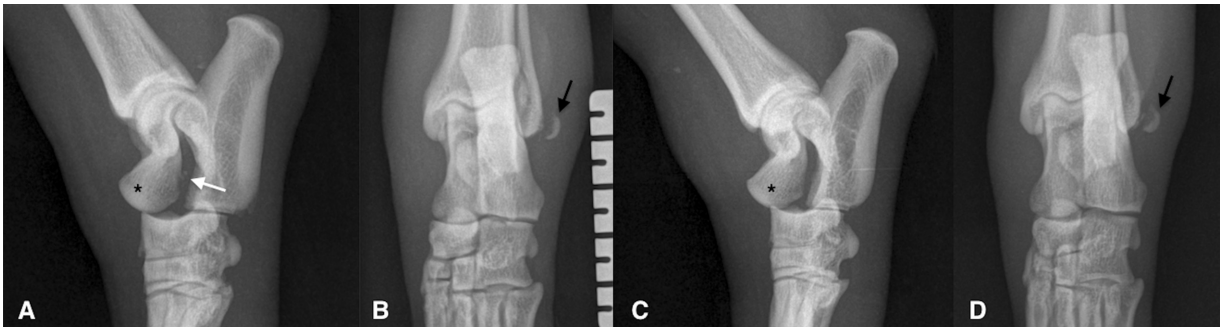

Fig. 1 Preoperative left (**A**, **B**) and right (**C**, **D**) mediolateral and dorsoplantar radiographs of a 4-year-old, 25 kg, male, castrated, Collie cross with bilateral talocalcaneal and dorsal displacement of the head of the talus (*asterisk*). Small mineral fragments are present between the talus and calcaneus consistent with avulsion fractures (*white arrow*). A bilateral avulsion fracture of the lateral malleolus is also present (*black arrow*).

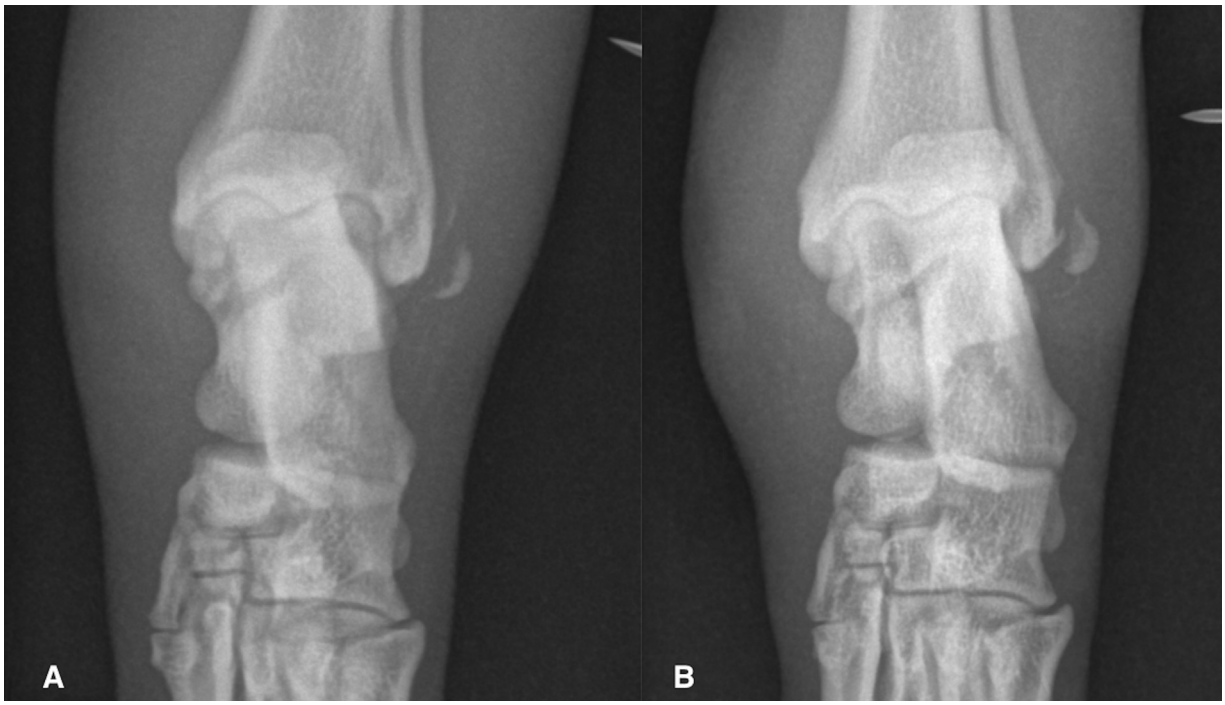

Fig. 2 Preoperative left (**A**) and right (**B**) dorsoplantar preoperative stressed (varus) radiographs of the same dog in ►**Fig. 1** demonstrating absence of obvious lateral collateral instability.

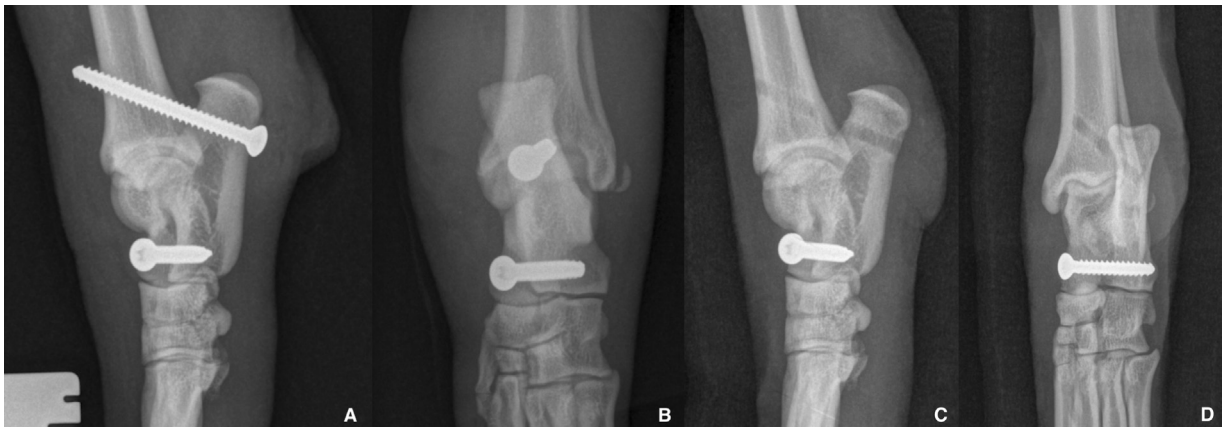

Fig. 3 Immediate postoperative (**A**, **B**) and 6-week postoperative (after calcaneotibial screw removal) (**C**, **D**) mediolateral and dorsoplantar radiographs of the right tarsus of the same dog in ►**Fig. 1** demonstrating reduction and stabilization of the talocalcaneal and talocalcaneocentral luxation.

amoxicillin clavulanic acid (20 mg/kg PO q12hrs) was continued for 10 days postoperatively on the basis of the skin wounds and abrasions of the caudal abdomen. Exercise was restricted for 6 weeks, and modified Robert Jones bandages were changed 2 days postoperatively and then weekly. On the day of discharge, the dog was not able to ambulate without sling support.

At 6 weeks postoperatively, the owner described significant improvement in the dog's ability to ambulate, with the dog reported to be walking almost normally. The dog was not receiving any medication and exercise continued to be curtailed to short leash walks. On subjective gait assessment at our institution, mild bilateral pelvic limb lameness was identified at the walk. There was mild dermatitis of both pelvic limbs identified after removal of the bandages. Mediolateral and dorsoplantar radiographs of the tarsi identified static surgical implants and a partially healed avulsion fracture of the right lateral malleolus (not visible on the left possibly due to obliquity of projection). Both calcaneotibial screws were removed under general anaesthesia and submitted for microbial culture. No bacterial growth was identified. Light bandages were applied for 3 days.

At 14 weeks after the initial surgery, the owner reported very mild intermittent lameness. The dog was receiving 15 to 20 minutes leash walks per day and no medication. On subjective gait assessment at our institution, no lameness was identified. There was mildly decreased flexion of both tarsi. No pain, effusion, crepitus or valgus/varus instability was identified. Radiographs identified static appearance of the talocalcaneal screws, absence of tarsal instability on stressed projections and

Fig. 4 Fourteen-week postoperative mediolateral and dorsoplantar radiographs of the left (**A**, **B**) and right (**C**, **D**) tarsi of the same dog in ►**Fig. 1** demonstrating static appearance of the talocalcaneal screws and similar appearance of avulsion fractures of the lateral malleoli.

similar appearance of avulsion fractures of lateral malleoli (►**Fig. 4**). A gradual increase in exercise activity over 6 weeks until return to normal activity was advised.

The dog was re-presented again to our institution at 12 months postoperatively for orthopaedic examination and radiographs of both tarsi. No lameness was reported and the dog was not receiving any medication or exercise restriction. No lameness was identified on subjective gait assessment and orthopaedic examination revealed no evidence of pain, effusion, crepitus, reduced range of motion or varus/valgus instability in either tarsus. Plain and stressed radiographs of both tarsi identified static positioning of the talocalcaneal screws without evidence of implant failure, similar appearance of the avulsion fracture of the lateral malleolus bilaterally and the presence of mild (left)-to-moderate (right) osteoarthritis affecting the talocalcaneocentral and centrodistal joints (►**Fig. 5**).

Discussion

Although limited to only a single case, this is the first description of bilateral talocalcaneal and talocalcaneocentral luxation in a dog and the first to report the long-term clinical and radiographic outcome following bilateral talocalcaneal screw placement. Radiographic follow-up within previous reports of talocalcaneal and talocalcaneocentral luxation in dogs is limited to 2 months.[2,3,5] This case report highlights that a successful clinical outcome with absence of visible lameness can be achieved with bilateral placement of a single positional talocalcaneal screw; however, development of osteoarthritis affecting the proximal and distal intertarsal joints may be expected in the long-term.

In our case, talocalcaneal screw placement was augmented with a calcaneotibial screw, which may or may not have been necessary to achieve a successful outcome. It has been proposed that stabilizing the talus and calcaneus in cases of talocalcaneal and talocalcaneocentral luxation results in stabilization of the proximal intertarsal joint as long as the collateral ligaments are intact.[1] Preoperative radiographs in our case identified a bilateral lateral malleolar avulsion fracture.[3,4] A similar injury was reported in a case report by Hurter[3] and was associated with disruption of the lateral collateral ligament and lateral instability of the tarsocrural joint. In another report,[4] no instability was associated with this avulsion fracture of the lateral malleolus. In our case, preoperative varus stressed views did not identify evidence

Fig. 5 Twelve-month postoperative mediolateral and dorsoplantar radiographs of the left (**A**, **B**) and right (**C**, **D**) tarsi of the same dog in ►**Fig. 1** demonstrating static positioning of the talocalcaneal screws without evidence of implant failure, similar appearance of the avulsion fracture of the lateral malleolus bilaterally and the presence of mild (left)-to-moderate (right) osteoarthritis affecting the talocalcaneocentral and centrodistal joints.

of lateral instability; however, re-luxation easily reoccurred with manipulation. While no clinically detectable instability was identified in either tarsus after talocalcaneal screw placement, rather than performing a separate surgical approach to permit inspection of the lateral collateral ligament, a temporary calcaneotibial screw was applied on both sides. This was intended to temporarily stabilize the tarsocrural joint had the lateral collateral ligament been injured.[1] The results of one *ex vivo* study demonstrated that calcaneotibial screw fixation provides stabilization of the tarsocrural joint in a collateral ligament injury model.[8] Placement of a temporary calcaneotibial screw has not been described in previously reported cases of talocalcaneal and talocalcaneocentral luxation in dogs.

All previously published descriptions of talocalcaneal luxation/subluxation in dogs involved a single pelvic limb,[2–7] and only three of these include concurrent talocalcaneal luxation, similar to our case.[2,3,5] Within these three reports,[2,3,5] treatment options include arthrodesis of the talocentral joint using a dynamic compression plate,[3] placement of a positional calcaneotalar screw[2] and placement of a talocalcaneal screw in lag fashion.[5] Gorse and colleagues[5] described talocalcaneal luxation in five dogs, with two dogs having concurrent displacement between the talus and central tarsal bone.[5] Both of these dogs sustained additional tarsal injuries including chip or slab fractures of the talar ridges or calcaneus.[5] One dog received auxiliary fixation with a figure-of-eight wire placed around screws inserted in the talus and central tarsal bone, in combination with Kirschner wires across the talocentral joint, and in the second dog, concurrent tarsocrural (using a screw) and intertarsal joint (using pins and tension band) arthrodesis was performed.[5] It has been proposed that placement of a screw across the talocalcaneal joint without arthrodesis of the joint could subject the screw to cyclic loading and failure because of residual motion between the two bones; however, this has not been reported.[1] In a single case of talocalcaneal subluxation in a dog, arthrodesis of the talocalcaneal joint was performed by means of curettage of the articular cartilage and placement of a single talocalcaneal screw; however, no radiographic follow-up is available in that report.[7] In our case, arthrodesis of the talocalcaneal joint was not performed and no evidence of implant failure was identified on long-term postoperative radiographs.

Reports describing outcomes of dogs with talocalcaneal and concurrent talocalcaneocentral luxation are limited.[2,3,5] No postoperative complications were encountered in our case during the available 12-month follow-up period, apart from mild bandage related dermatitis. Hurter[3] described splitting of a small lateral malleolar avulsion fragment during attempted re-attachment in one dog. The same dog also experienced a single postoperative complication that included screw loosening at 2 months postoperatively, which required explantation. The dog made a full recovery and demonstrated no lameness during the subsequent 6-month follow-up period.[3] One dog with talocalcaneal luxation and plantar displacement of the head of the talus treated with calcaneotalar screw placement experienced no intraoperative or postoperative complications and had a normal gait at 3 months and mild stiffness after strenuous exercise at 1 year postoperatively.[2] The authors of that report[2] do not provide justification for why they placed the screw from the distal calcaneus to the head of the talus. Similar to how one would repair a fracture–luxation of the central tarsal bone, we placed the screw from the displaced/luxated bone (the head of the talus in our case) to the fixed bone (the calcaneus in our case).[1] In the report by Gorse and colleagues,[5] which included two dogs with displacement between the talus and central tarsal bone, no intraoperative complications occurred; however, one dog that received auxiliary fixation with a figure-of-eight wire around screws inserted in the talus and central tarsal bones and Kirschner wires placed across the talocentral joint experienced a minor postoperative fracture of periosteal new bone at the proximal intertarsal joint.[5] Another dog that underwent concurrent tarsocrural (using a screw) and intertarsal joint arthrodesis (using pins and tension band) developed osteomyelitis and non-union of the arthrodesis.[5] This was the only one of five dogs with talocalcaneal luxation not to achieve resolution of lameness.[5] Regarding cases of talocalcaneal separation/subluxation,[4,6,7] no intraoperative or postoperative complications were reported by Nanfelt and colleagues[4] and the dog demonstrated minimal lameness at 8 weeks. In a single case by Lawson,[7] good recovery was reported 3 months after talocalcaneal arthrodesis and talocalcaneal screw placement. No postoperative outcome was described for the two surgically treated cases of talocalcaneocentral displacement in a case series by Campbell and colleagues[6] and a satisfactory outcome was described in one case of talocalcaneal subluxation managed with external support in the same report.

Surgical management of talocalcaneal luxation is typically recommended.[1] It is suggested that cases with mild displacement between the talus and calcaneus can be managed conservatively with splint application.[1] Two reports describe treatment of talocalcaneal separation/subluxation with external coaptation.[5,6] In one of these reports,[6] application of external support was reported to have proved satisfactory, while return to preoperative level of function with resolution of lameness was reported in the other.[5] Use of temporary external coaptation after surgical repair has been variably described in previously reported cases of talocalcaneal and talocalcaneocentral luxation.[2,3,5] One surgical textbook recommends application of a lateral splint and soft padded bandage for 4 weeks, followed by a soft padded bandage for 2 weeks.[1] In our case, a full limb modified Robert Jones was applied to each pelvic limb for 5 weeks postoperatively in an effort to protect the repair and mild dermatitis was the only complication observed. We acknowledge that maintenance of a bandage for 5 weeks postoperatively in addition to placement of a calcaneotibial screw may not have been completely necessary, particularly considering the high rate of soft tissue injuries associated with external coaptation in dogs.[9]

We acknowledge several important limitations in this report, not least of which is the fact that it includes only a single case. Force plate analysis was not performed as it is not available at

our institution and therefore although no lameness was identified on subjective gait assessment at the time of long-term follow-up, the possibility of shifting of weight to the thoracic limbs given the bilateral nature of the injury cannot be excluded. Preoperative computed tomography was not performed in our case; however, it was not deemed likely to provide additional information over plain and stressed radiographs. This is the first description of bilateral talocalcaneal and talocalcaneocentral luxation in a dog and the first to report the long-term clinical and radiographic outcome of an affected dog. This report highlights that a successful clinical outcome with absence of visible lameness can be achieved with bilateral placement of a single positional talocalcaneal screw; however, development of osteoarthritis affecting the proximal and distal intertarsal joints may be expected in the long-term. Future studies involving a greater number of dogs are required to specify the long-term outcome and complication rate associated with talocalcaneal and talocalcaneocentral luxation in dogs.

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Conflict of Interest
None declared.

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