**Surgical management of a Lateral Luxation of the Tendon of the Superficial Digital Flexor Muscle using an Autologous Fascia Lata Graft**

**Summary**

An 18-month-old, 23kg, neutered male Staffordshire bull terrier was presented with acute left pelvic limb lameness. There was marked swelling at the level of the tuber calcanei and lateral luxation of the tendon of the superficial digital flexor muscle (TSDFM) was palpable. Surgical correction included replacement of the TSDFM before apposition of the retinacular tissues. An autologous fascia lata (FL) graft was harvested from the ipsilateral limb and sutured over the primary suture line as augmentation. A modified Robert-Jones bandage with caudally positioned splint was placed for twelve days and five-minute lead exercise was started after six weeks.

At ten and fourteen weeks post-operatively the dog was exercising without evidence of lameness or clinical signs. Subjective grading by the attending veterinary surgeon (ECVS boarded surgeon) revealed no lameness at either time point (VAS score 0/10). A clinical metrology questionnaire revealed normal mobility (Liverpool OsteoArthritis in Dogs questionnaire (LOAD) score 3).

**Background**

Luxation of the tendon of the superficial digital flexor muscle (TSDFM) is a rarely described condition in dogs, with Shetland sheepdogs and Border collies being the most common breeds previously reported (1-3). The superficial digital flexor muscle arises from the supracondylar tuberosity of the femur and winds distally and medially around the tendon of the gastrocnemius a the level of the mid-tibia (4). The TSDFM then passes over a large bursa (bursa calcanei) on the tuber calcanei, forming a cap-like structure over the tuber calcanei. A portion of the TSDFM inserts collaterally on the calcaneus before continuing to its final insertion on the middle phalanges of the second to fifth digits (4). The TSDFM is integral to normal locomotion acting to flex the digits, extend the tarsus and flex the stifle joint (4).

Lateral luxation of the TSDFM is most commonly reported with weaker medial attachment of tissues to the tuber calcanei previously incited (5). To date, there are reports of primary repair failure (6) where revision surgery using a polypropylene mesh for augmentation of the retinacular tissues is reported (6). Fascia lata (FL) grafts have been reported in dogs for urethral, ligamentous and perineal hernia reconstructions (7-9), and are an autologous alternative to polypropylene mesh (10). The present report is the first to describe an autologous FL graft to augment repair of luxation of the TSDFM.

**Case Presentation**

An 18-month-old, 23kg, neutered male Staffordshire bull terrier was presented with a history of acute left pelvic limb lameness. The lameness had occurred acutely 48-hours earlier whilst exercising normally. On presentation, the dog was bright and alert with a body condition score 4/9. A moderate (graded 6/10) left pelvic limb lameness was noted at walk with intermittent non-weight bearing at trot. There was marked swelling at the level of the tuber calcanei with a pain response elicited on palpation. Range of motion of the left tarsus was otherwise normal. Upon flexion of the left tarsus, lateral luxation of the TSDFTM was palpable. Further general examination was unremarkable.

**Investigations**

Radiographs of the left tarsus showed a marked circumferential soft tissue swelling at the level of the insertion of the calcaneal tendon (Figures 1A and B). The skeletal structures were radiographically normal.

Ultrasonography was carried out using a 3-16MHz linear transducer (Samsung RS80A, Samsung Healthcare, UK). On ultrasonographic assessment of the left tarsus there was loss of definition of the normal fibril pattern within the gastrocnemius and superficial digital flexor tendons at a level just proximal to the calcaneus and the conjoined tendon was poorly visualised (Figures 2A and B). There was distension of the common tendon sheath by anechoic effusion. Under transducer pressure, the TSDFM could be luxated laterally off the tuber calcanei (Figure 2B).

**Treatment**

Perioperatively the dog received an intramuscular pre-medication of medetomidine (8µg/kg) (Medetor, Virbac), acepromazine (8µg/kg) (ACP, Elanco) and methadone (0.3mg/kg) (Synthadon, Animalcare). Induction of general anaesthesia was performed using intravenous propofol to effect (23mg total dose)(PropoFlo Plus, Zoetis). The dog received femoral/sciatic regional anaesthesia using levobupivacaine (1mg/kg) (Chirocaine, Abbvie) as part of a multimodal analgesic protocol. Cefuroxime (20mg/kg) (Zinacef, GlaxoSmithKline) was used for perioperative antibiotic therapy after induction and repeated every 90 minutes for the duration of the surgery.

The FL graft was harvested as previously described (11). In brief, the dog was positioned in right lateral recumbency for initial quarter draping and final large sterile draping isolating the left pelvic limb. An 8cm skin incision over the lateral thigh, mid-way down the femur was made. The underlying subcutaneous tissues were undermined exposing the FL. A 7cm x 2.5cm sheet of the tendinous FL was excised from the superficial leaf and placed extended in a saline soaked swab. The FL incision, subcutaneous tissues and skin were closed routinely.

The dog was rotated into sternal recumbency and a 4cm plantaromedial skin incision was made centred over the left tuber calcanei. The underlying subcutaneous fascia was separated revealing a longitudinal tear in the medial retinacular structures, exposure of the tuber calcanei and lateral luxation of the TSDFM (Figures 3A and B). The TSDFM was replaced over the tuber calcanei before apposition of the retinacular tissues using ten simple interrupted polypropylene sutures (Prolene 3M, Ethicon). The sutures were pre-placed before alternating between proximal and distal tying of the knots (Figures 4A and B).

The FL graft was sutured over the primary suture line to create a “sling’ in which the TSDFM was freely mobile. The length of the FL graft was cut to allow the graft to extend 5mm proximal and 5mm distal to the primary suture line. The medial margin was sutured to the medial retinacular tissues approximately 5mm medial to the primary suture line using simple interrupted polypropylene sutures (Prolene 3M, Ethicon). The graft was then placed with moderate tension over the suture line, tuber calcanei and TSDFM, and sutured to the lateral retinacular tissues, approximately 5mm lateral to the SDFT, using simple interrupted polypropylene sutures (Prolene 3M, Ethicon) (Figure 5). Excess FL was subsequently removed using Metzenbaum scissors. Once placed the TSDFM was not amenable to luxation in either direction during flexion of the tarsus or under direct manual pressure. The subcutaneous tissues and skin were apposed routinely.

The dog recovered uneventfully, and a modified Robert-Jones bandage with caudally positioned custom fibreglass splint was placed. Post-operatively the dog received methadone (0.2mg/kg IV Q4h) (Synthadon, Animalcare) and paracetamol (10mg/kg IV TID) (Paracetamol, B. Braun). The dog was discharged the following day and prescribed meloxicam (0.1mg/kg PO SID) (Metacam, Boehringer Ingelheim) and paracetamol (10mg/kg PO TID) for a week. Discharge instructions included strict rest for six weeks, with bandage changes every two days at the University hospital. After twelve days the bandage and skin sutures were removed. The dog started five-minute lead walks three times daily at six weeks with exercise duration increased by five minutes after each week. Off-lead exercise was initiated at twelve weeks post-operatively.

**Outcome and Follow-up**

The dog was assessed at ten and fourteen weeks post-operatively. At these timepoints, the dog was exercising without any evidence of lameness or clinical signs according to the owner. Subjective grading by the attending veterinary surgeon (ECVS boarded surgeon) revealed no lameness at walk or trot at ten and fourteen weeks (VAS score 0/10). A clinical metrology questionnaire completed at fourteen weeks post-surgery revealed normal mobility (Liverpool OsteoArthritis in Dogs questionnaire (LOAD) score 3).

**Discussion**

This is the first report of an autologous FL graft being used as augmentation for lateral luxation of the TSDFM. Luxation of the TSDFM is rarely reported in dogs, with only four dogs reported in the last 20 years (12-14). Diagnosing luxation of the TSDFM is based on palpation. Specifically, when the tarsus is flexed the TSDFM will luxate, and upon extension of the tarsus the tendon can reduce to its normal position (1). Medical management of luxation of the TSDFM yields poor results (6) therefore surgery is recommended (3, 12). Surgical textbooks recommend management by primary apposition of the retinacular tear to manage luxation of the TSDFM however a scarcity of literature means outcome is limited to a small number of cases. Synthetic mesh has been described adjunctive to revision closure of the retinaculum in dogs (6). We had concerns regarding the ability of primary retinacular repair alone to resist the active and boisterous nature of the Staffordshire Bull Terrier breed. Furthermore, given this dog’s age, long-term exercise requirements and efficient nature of the surgery, we elected to augment the primary retinacular repair using an autologous FL graft during initial surgery. We postulated that failure risk would be reduced with this approach.

The FL graft has been used extensively in human surgery including tendon repair (15-17), and has been used as augmentation for successful common calcaneal tendon repair in two dogs (18, 19). Autologous grafts have numerous advantages over allogenic grafts including low infection rate, no disease transmission, biocompatibility and lower cost (16). The FL graft specifically is relatively simple to harvest, is readily available with minimal donor site morbidity and reported to have superior biomechanical properties in comparison to other free fascial grafts (11, 20). Experimentally, free FL grafts have been shown to revascularize confirming integration and long-term viability (21). Furthermore, allogenic FL was shown to have proliferation of fibroblasts throughout its construct unlike polypropylene mesh (19) which is important for tissue regeneration post-implantation. Given the histological features, in vivo integration into surrounding tissues of the FL would be expected (19).

The use of synthetic mesh for surgical reconstruction is not without risk, with adherence to local tissues, soft tissue erosion, foreign body reaction and chronic infections all documented in human and veterinary literature (11, 22, 23). Maintaining the free sliding motion of the TSDFM during tarsal motion was imperative for post-operative function. Therefore a FL graft was deemed most suitable after extrapolating evidence from FL graft use in abdominal hernia repair where a noticeable lack of adhesions between graft and mobile viscera has been highlighted (21). Biomechanically, FL grafts have superior or similar properties to polypropylene mesh (10). Whilst experimentally, free FL grafts are more resistant to infection in comparison to prosthetic mesh (21) and unlike synthetic mesh, do not require removal in the face of infection (24).

The cause of luxation of the TSDFM has been speculated on previously as a heritable trait (25), due to weaker medial retinacular attachments to the calcaneus (5) and/or due to anatomical variation (1-3, 6, 12). In the latter case, the tuber calcanei groove would be expected to be shallow and have a distolateral slant, however this was not present radiographically or during surgery. This injury was therefore attributed to a traumatic event, which is in concordance with previous veterinary cases (1, 2).

Primary apposition of the retinacular tissues has been described using a variety of suture materials and suture patterns (1-3, 12). We used polypropylene on the basis of its inertia and prolonged strength. We decided on a simple interrupted appositional pattern because unlike in transverse tendon tears, sutures placed for longitudinal tears do not tend to pull out when the tendon is loaded (12).

Post-operative external coaptation has been reported as necessary to protect the lower limb with previous reports placing external coaptation for over three weeks (1, 2, 6, 12). Prolonged external coaptation is a well-established common cause of complications following surgery of the tarsus (26, 27). Although external coaptation was placed for 12 days in this case, in retrospect the authors speculate that augmentation of the primary repair using the FL graft may remove the need to apply external coaptation postoperatively in these cases.

Subjective post-operative assessment was performed by a visual analogue scale assessment and clinical metrology questionnaire (LOAD). Visual analogue scales are used extensively as an outcome measure in orthopaedic studies (28, 29), while the LOAD questionnaire has been previously correlated with force-platform data (30). Both of these assessments along with owner assessment suggested that no lameness was apparent ten and fourteen weeks following surgery.

Acute lateral luxation of the TSDFM was successfully managed by primary apposition of the medial retinacular structures and augmentation with an autologous FL graft.

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**Figure Captions**

**Figure 1:** **A:** Mediolateral and **B:** plantarodorsal radiographs demonstrating marked swelling of the insertion of the calcanean tendon onto the tuber calcanei, seen circumferentially on the plantarodorsal projection (asterisk).

**Figure 2A and 2B:** Sagittal ultrasound images (proximal to the left) of the insertions of the superficial digital flexor (SDFT) and gastrocnemius (G) tendons onto the tuber calcanei, prior to (A) and following (B) manual luxation of the tendon. The SDFT was observed to luxate laterally and there was loss of the normal fibril pattern within the SDFT and G tendons. There was moderate effusion (eff) of the tendon sheath.

**Figure 3A and 3B**: Plantaromedial skin incision centered over the left tarsus exposing a longitudinal medial retinacular tear (Thin white arrow) and lateral luxation of the tendon of the superficial digital flexor muscle (TSDFM) (white arrowhead) from the tuber calcanei (asterisk) and **B**: Replacement of the tendon of the superficial flexor tendon muscle (white arrowhead) onto the tuber calcanei. Longitudinal medial retinacular tear is visible (Thin white arrow)

**Figure 4A:** Primary repair of the longitudinal medial retinacular tear with pre-placement of polypropylene sutures (3M Prolene, Ethicon)and **B:** Primary apposition of the medial retinacular tear using ten simple interrupted polypropylene sutures (3M Prolene, Ethicon).

**Figure 5**: Fascia lata graft placed over and sutured collaterally to the primary suture line, tuber calcanei and tendon of the superficial digital flexor muscle using simple interrupted polypropylene sutures (3M Prolene, Ethicon).