Mineralization of the Equine Palmar/Plantar Annular Ligament Treated by Surgical Resection

Keywords: annular ligament; mineralisation; equine; lameness; ultrasonography

Elaine R. Garvican[a], Claire E. Wylie[b], Richard J. Payne[b], Roger K.W. Smith[a], Marcus J. Head[b]

[a] Department of Clinical Science and Services, The Royal Veterinary College, Hertfordshire, United Kingdom

[b] Rossdales Equine Hospital and Diagnostic Centre, Suffolk, United Kingdom

Abstract:

Objective

To document the clinical presentation, diagnosis, and surgical treatment of mineralization of the equine palmar/plantar annular ligament (PAL).

Study Design

Retrospective study.

Animals

Ponies (n=7).

Methods

Case records from 2 referral hospitals were examined to identify cases with lameness associated with PAL mineralization treated surgically. Follow-up information was obtained from the owners by telephone questionnaire.

Results

Duration of lameness before referral ranged from 5 weeks to 6 months, and degree of lameness from grade 1 to 5 out of 10. In 3 cases, records noted obvious pain when pressure was applied over the PAL. Pain resulting in lameness was localized to this area and all cases were treated surgically, although the extent of resected tissue varied among cases. Histological examination of resected tissue (4 cases) revealed fibrocartilaginous and/or osseous metaplasia. Following surgery, 6 of the 7 ponies became sound.

Conclusion

Based on this limited case series, surgical treatment for mineralization of the PAL offers a favorable success rate without severe complications where conservative methods have failed.

Introduction:

The palmar/plantar annular ligament (PAL) lies on the palmar/plantar aspect of the metacarpo/metatarso-phalangeal (fetlock) joint and acts to retain the superficial digital flexor (SDFT) and the deep digital flexor (DDFT) tendons within the fetlock canal. The PAL originates on the palmar/plantar border of the proximal sesamoid bones and also resists abaxial movement of the proximal sesamoid bones during extension of the fetlock [1, 2].

Imaging of the PAL is usually achieved with ultrasound [3], although differentiation from the underlying synovial lining of the digital sheath and the variably involved overlying subcutaneous tissues (making up the 'PAL complex') can be challenging [4]. The PAL is best imaged in multiple orientations to ensure an accurate delineation of the ligament – transverse and longitudinally over the palmar/plantar aspect, and over the palmar/plantar borders of the proximal sesamoid bones where the PAL attachments can be identified. In those cases where identification of the ligament itself is difficult, the distance between the palmar/plantar border of the SDFT and the skin has been used as a substitute measurement for PAL thickening [5].

Annular ligament syndrome refers to a persistent lameness resulting from constriction and restriction of the flexor tendons by the PAL [3, 6, 7] and arises from thickening of the PAL and a reduction in the luminal diameter of the fetlock canal and/or from thickening of the tendons within a normally sized fetlock canal. Annular ligament syndrome classically presents with a proximal (and occasionally distal) distension of the digital flexor tendon sheath and a concave notch at the level of the PAL [3, 8]. These signs are often used as an indicator of constriction; however, true constriction is difficult to establish definitively without tenoscopic appraisal. It is hypothesized that

complete desmotomy of the PAL will only benefit the horse when constriction is present [9, 10]. The normal thickness of the PAL in Thoroughbreds is reported to be 1-2 mm, with 2-7 mm considered normal in cobs [10]. The etiology of this thickening is often unclear and potentially multifactorial. It may be associated with subcutaneous fibrosis and swelling to the palmar/plantar aspect of the fetlock joint, termed annular ligament desmitis or PAL desmopathy [11, 12].

We have observed chronic lameness associated with mineralization of the PAL in a number of ponies. We hypothesized that these changes were a cause of lameness and that in cases where conservative management fails to resolve the lameness, subtotal or total surgical resection of the damaged PAL is an appropriate and successful therapeutic strategy for this disease. This report describes the surgical approach and long-term outcome for the treatment of annular ligament mineralization.

Materials and Methods:

Case Selection:

Retrospective ethical approval for this study was obtained from the Animal Health Trust Ethics Committee. Animals were selected for inclusion in this study based on lameness attributable to mineralization within the PAL that was subsequently treated surgically. Case records from The Royal Veterinary College and Rossdales Equine Hospital were reviewed and, where available, data were recorded, including age, breed, sex, history, affected limb, results of physical examination, lameness examination findings (including response to diagnostic analgesia), results of ultrasonographic and radiographic examination, surgical treatment, gross and histological findings, and outcome.

Regional Analgesia

Perineural analgesia was performed by infiltration of 2 mL mepivacaine around the relevant nerve (palmar/plantar digital nerves at the level of the proximal sesamoid bones; palmar/plantar nerves proximal to the digital flexor tendon sheath; palmar/plantar metacarpal nerves) and gait reassessment was performed after 15 minutes. Analgesia of the digital flexor tendon sheath was achieved by injection of 10 mL mepivacaine using a 20 gauge, 1 inch needle inserted on the midline into the distal palmar/plantar pouch. Reassessment was performed 10 and 40 minutes later.

Surgical intervention:

All ponies were administered perioperative phenylbutazone (2.2 mg/kg IV immediately before surgery and 2.2 mg/kg orally once or twice daily for 1–7 days postoperatively), along with broad spectrum antibiotics (regimen dependent on hospital protocol and

case specifics) for 3–7 days. Surgery was performed under general anesthesia in either lateral (with the affected limb positioned uppermost) or dorsal recumbency, according to surgeon preference on positioning for tenoscopy, and an Esmarch bandage was used as a tourniquet on the affected limb. Tenoscopic evaluation of the contents of the digital flexor tendon sheath was performed in all cases to rule out any additional pathology. Under direct tenoscopic visualization, a 21 gauge, 1.5 inch marker needle was placed horizontally across the palmar/plantar border of the SDFT, level with the lesion, between the SDFT and the PAL to help identify the division between the PAL and SDFT. A curved longitudinal surgical incision was then made across the palmar/plantar aspect of the PAL with its base at the medial/lateral proximal sesamoid bone. Subcutaneous tissue was divided and the axial margin of the sesamoid bone identified by palpation. The incision was continued through the PAL from below its distal border, alongside the mineralized area or its attachment to the palmar/plantar border of the sesamoid bone, to its proximal border. The PAL was reflected medially/laterally along with the primary skin flap. The PAL was dissected free of subcutaneous tissue beneath the skin flap incision and once isolated cut sharply using a pair of curved mayo scissors along its attachment to the axial border of the opposite sesamoid bone or, for more limited resection, along the opposite side of the mineralized area. The PAL section containing mineralized changes (in 3 cases the entire PAL) was removed and in 4 cases submitted for histology. The digital flexor tendon sheath was flushed with Lactated Ringers Solution and the skin flap was replaced and sutured using a 3 layer closure (simple continuous sutures of 3.5 metric polyglactin 910 in the subcutaneous tissues and subcuticular layer, followed by vertical mattress sutures of 3.5 metric monofilament nylon or skin staples, according to

surgeon preference). Arthroscopic portals were closed with simple interrupted sutures of 3.5 metric monofilament nylon.

The distal aspect of the limb was supported and protected for recovery from general anesthesia in a Robert Jones bandage (5 limbs) or distal limb cast (2 limbs) according to surgeon preference. Casts were maintained for 2 weeks postoperatively and distal limb bandages were maintained for up to 4 weeks.

Post-operative care:

Following the initial 2–4 week period of stall rest, ponies were walked in hand for increasing amounts of time (5–30 minutes) over a 4–6 week period, then re-examined by a veterinary surgeon. A further month of turnout in a small paddock was then recommended before gradual return to work.

Outcome:

Owners were contacted by means of a structured telephone questionnaire between November and December 2013 to obtain follow-up data. Owners were asked for information regarding preoperative use of the pony, current use of the pony, reasons for a discrepancy in preoperative and postoperative use, whether the pony was currently sound on the operated limb, and details of any problems related to surgery.

Results:

Seven ponies met the inclusion criteria (6 mares and 1 gelding). Breeds represented were Welsh/Welsh cross, Fell, and Highland (2 ponies each), and unknown breed (1 pony). Age range was 8–15 years (median 12 years). Duration of lameness before referral ranged from 5 weeks to 6 months (median time to presentation 4 months).

Six ponies presented with forelimb and 1 pony with hindlimb lameness. The median degree of lameness (assessed in a straight line at the trot) was 3.2 and ranged from grade 1 to 5 out of 10. Firm swelling was present over the palmar/plantar aspect of the metacarpo/metatarsophalangeal joint in all cases and in 3 ponies this swelling was painful on deep palpation. In only 3 ponies, significant digital flexor tendon sheath effusion was also noted.

Response to regional and intrasynovial analgesia varied. In 6 of 7 ponies, lameness was abolished at the referral center after analgesia of the palmar nerves at the level of the proximal sesamoid bones (1 pony), the palmar/plantar nerves immediately proximal to the digital flexor tendon sheath (3 ponies), or by injection of the digital flexor tendon sheath (2 ponies). Diagnostic analgesia in the remaining pony had been performed by the referring veterinarian, with pain resulting in lameness localized to the region of the palmar fetlock through analgesia of the palmar nerves proximal to the digital sheath.

Radiography was performed in all cases. Radiographic abnormalities were detected in 6 limbs, most commonly taking the form of small, irregular, mineralized opacities palmar to the fetlock in the region of the PAL (Fig 1A) and associated regional soft tissue swelling. In 1 pony, no radiographic abnormalities were detected. Ultrasonography was performed in all cases and revealed a thickened PAL of

heterogeneous echogenicity containing hyperechoic foci cast an acoustic shadow and ranged in size from 2 × 3 mm to 8 × 10 mm in size (Fig 1B).

Surgical intervention was recommended based on localization of pain resulting in lameness to a lesion evident radiographically and/or ultrasonographically within the PAL. Tenoscopic examination revealed fibrillation of the opposing SDFT in 2 ponies. In 2 ponies, a defect was visible in the PAL through which the mineralized area impinged on the tendon (Fig 2). There was no tenoscopic evidence of constriction of the PAL in any limb (assessed intraoperatively by lack of resistance to passage of the endoscope). The extent of the lesion in 3 cases required resection of the entire PAL. In the remaining 4 cases, resection was localized to the site of mineralization, resulting in a resection of an estimated 20–50% of the PAL. Histological examination was performed on tissue resected from 4 limbs and revealed osseous metaplasia (Fig 3) or dystrophic mineralization.

All ponies recovered and were discharged from the hospitals without complications. Four cases were re-examined at the referral center 4–8 weeks postoperatively, with the remainder being managed by the referring practitioner. Length of follow-up ranged from 6 to 57 months (mean length 37 months; the pony for which follow-up was only available for 6 months had been on loan to the presenting client and after postoperative rehabilitation was returned to the owner and subsequently lost to further follow-up). Within 6 months of surgery, 6 ponies were sound on the operated limb. Five ponies had returned to work. Three of those 5 ponies returned to the previous level of activity or higher (general purpose/pony club) and 2 to a lower level of activity (general purpose). One pony remained out of work for reasons not attributable to the operated limb (impinging spinous processes). One pony remained lame with remaining slight distension of the digital flexor tendon sheath, but an otherwise

excellent cosmetic appearance. Residual forelimb lameness was subtle when this pony was trotted in a straight line (grade 1/10), but was exacerbated when the pony was lunged, particularly on a soft surface. Radiographs revealed new bone formation on the lateral proximal sesamoid at the attachment of the PAL. The digital flexor tendon sheath was subsequently medicated with corticosteroids, but the lameness was not abolished.

Average time to resumption of ridden activity in cases that became sound postoperatively was 2.7 months (mean 3 months). No postoperative complications were reported in any pony, and in all cases, postoperative cosmetic appearance was judged to be excellent with no cutaneous scarring (Fig 4).

Discussion:

Our study reports the clinical presentation, diagnosis, and surgical treatment of lameness caused by mineralization within the palmar/plantar annular ligament. The condition described in this report differs from PAL thickening, which is often secondary to primary pathology within the digital flexor tendon sheath and can cause constriction of the tendons within the fetlock canal [7]. In contrast, the cases described here are characterized by mineralization within the PAL that was considered to be the cause of lameness through clinical, ultrasonographic, or radiographic examination. Tenoscopic evaluation, as the gold standard, is still advised to ensure there is no accompanying pathology within the digital flexor tendon sheath. We hypothesized that these mineralized lesions cause pain either through a painful desmopathy or because of the mineralized lesion impinging on the underlying superficial digital flexor tendon. Consequently, the authors believe that this condition is part of a continuum of palmar

annular ligament desmopathy and propose the term palmar/plantar annular ligament mineralization.

The cases identified in this study suggest that PAL mineralization is more common in the forelimb and more commonly affects ponies or native breeds, but care should be taken to avoid overinterpretation of a relatively small, self-selecting population as PAL pathology is not limited to ponies alone. Generalized thickening of the PAL is a far more common finding in our case population and is frequently observed as a secondary change associated with prolonged digital flexor tendon sheath pathology. Direct trauma or indirect trauma by repeated hyperextension of the fetlock joint have been cited as causes of PAL desmitis [13]. While the causes of PAL mineralization remain unclear, no inciting exercise feature or historical trauma was identified. Natural repair of damaged soft tissues results in fibrosis and the accumulation of large proteoglycan structures, leading to the development of fibrocartilage [14]. As is common in other soft tissues, such as the DDFT, damaged tissues can undergo further metaplasia to form areas of fibrocartilage and subsequent mineralization, although this is not always painful. No association could be identified between the severity of pathological change and degree or duration of lameness (although in all cases, pathology was sufficiently established for mineralization to form). In one of the cases described here, the mineralized area had formed a sharp, linear edge that had resulted in a defect on the dorsal surface of the PAL, such that when the limb was loaded the sharp edge of mineralization was pushed through the defect in the PAL and into the superficial digital flexor tendon, resulting in both lameness and focal pain on palpation.

All the cases reported here presented with pain resulting in lameness that was localized to the region of the lesion and in some cases (3 of 7 reported here) with additional focal pain on palpation. Although the authors have not, to date, come across this condition as an incidental finding in a sound pony, this does not preclude the possibility of clinically insignificant mineralization of the PAL and would strongly caution against attributing lameness to such a lesion in the absence of supporting diagnostic analgesia. The varying pattern of diagnostic analgesia reflects the differences in size and location of the mineralization and the subsequent degree of impingement on surrounding structures. It is difficult to localize pain specifically to the PAL with regional perineural analgesia alone although a positive response to desensitization of the palmar nerves at the level of the abaxial surface of the proximal sesamoid bones or proximal to the digital tendon sheath would be the most specific. This response to analgesia would not be surprising given the proximity of the mineralization to the injection site and because of the ease with which diffusion of local anesthetic can desensitize the fetlock region [15]. Most of the reported lesions were located outside the digital flexor tendon sheath, so a positive response to injection of the flexor tendon sheath with local anesthetic solution would not necessarily be expected. In some cases, the mineralized lesion impinged on the underlying tendon and response to analgesia of the flexor tendon sheath was positive.

It was not always possible to be fully confident that the mineralized area was entirely within the boundaries of the PAL using radiography or ultrasound because of the difficulties in defining these boundaries using these imaging modalities. However, during surgery all mineralized foci were confirmed as being within the PAL. After localization of the pain resulting in lameness, diagnosis of palmar/plantar annular ligament mineralization is best achieved by careful ultrasonographic examination of

the PAL, whereupon an echogenic focus causing variable acoustic shadowing will be observed. In addition, radiography may reveal mineralization on the palmar aspect of the fetlock region.

Surgical resection appears to be well tolerated with no resulting complications, regardless of the extent of PAL removal, which will be driven largely by the size and nature of the lesion. Some cases described here presented with mineralization that was limited, contained, or well-demarcated, lending themselves favorably to localized resection. Where mineralization is more diffuse and boundaries poorly delineated, en bloc resection of the PAL may be necessary and appears to be successful, although it would seem logical to be as conservative as possible when considering the degree of PAL removal. In addition, the relative size of the animal and the ease of surgical access should be considered.

Open transection of the PAL has been associated with wound dehiscence and digital flexor tendon sheath sepsis [8, 16, 17]. The procedure described here carries the risk of these potential complications because of the more extensive surgery than the more commonly performed closed PAL transection under tenoscopic control. However, this was not observed in this small case series, possibly because of the postoperative use of a distal limb cast, or substantial Robert Jones bandage. The resultant immobilization of the surgical site is likely to have significantly contributed to the absence of postoperative complications and excellent healing. Owners should be prepared for a 3-6 month period of convalescence, after which the prognosis for return to work can be considered good.

In conclusion, this retrospective case series has identified a previously uncharacterized type of PAL lesion, which the authors recommend be referred to as

annular ligament mineralization. Where conservative methods have failed to resolve the lameness, surgical treatment offers a favorable prognosis without severe complications for palmar or plantar annular ligament mineralization.

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Figure Legends

Figure 1. Diagnostic imaging of a 14 year old pony mare diagnosed with annular ligament mineralization. (A) Lateromedial radiograph of the right metacarpophalageal joint showing mineralization (arrow) of the palmar annular ligament (PAL). (B) Longitudinal ultrasonograph at the level of the metacarpophalageal joint showing a hyperechogenic structure casting an acoustic shadow deep to it (arrow). Note that the subcutaneous tissues superficial to the SDFT are thickened. (C) Corresponding transverse ultrasonograph taken from the same level as B showing the mineralized area within a hypoechoic area of the PAL (arrow). DDFT, deep digital flexor tendon; SDFT, superficial digital flexor tendon; PSB, proximal sesamoid bone.

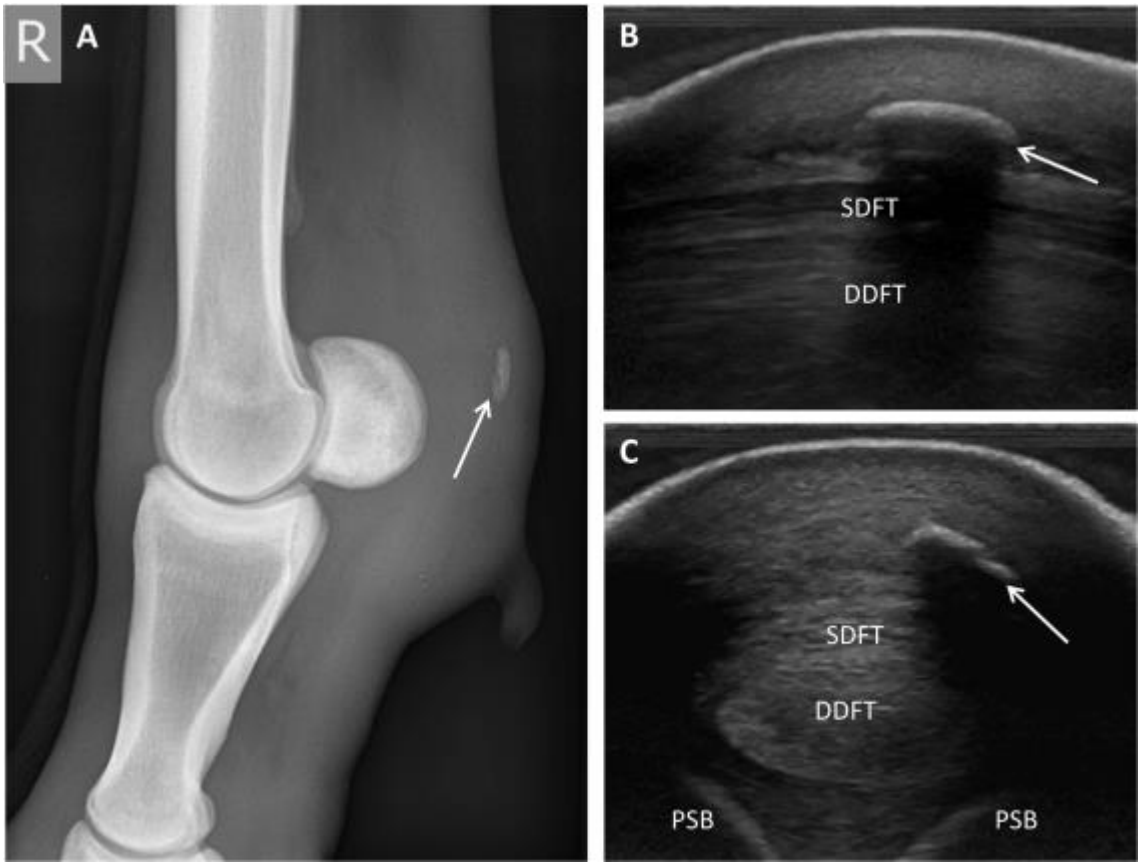

Figure 2. Pre-operative ultrasonographic images a) longitudinal view of case 4 showing extensive but regular, linear hyperechogenicity within the palmarolateral soft tissues; b) transverse view of case 4 showing extensive but regular, linear hyperechogenicity within the palmarolateral soft tissues of the lesions illustrated in Fig 1.

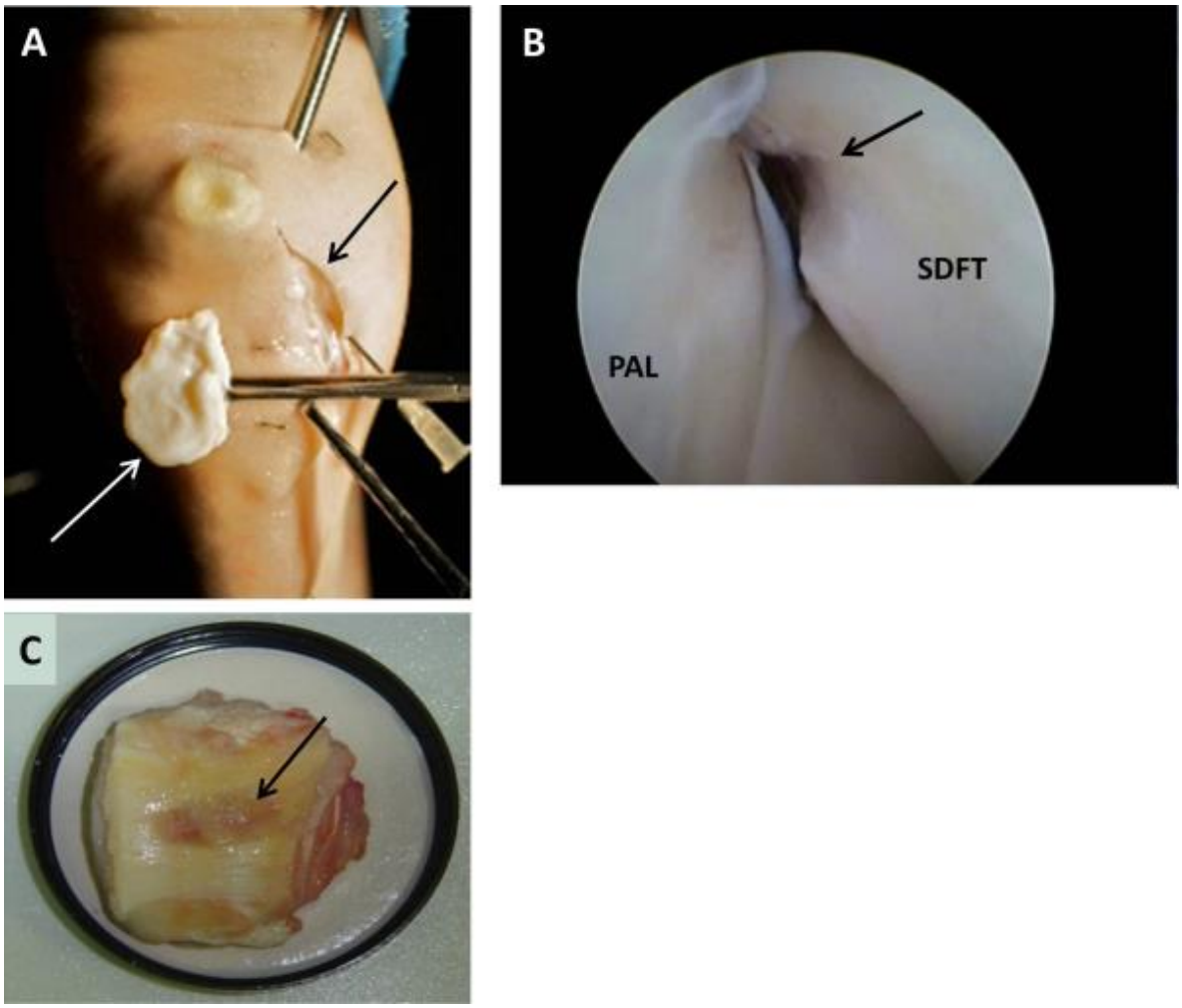

Figure 3. a) Intraoperative appearance of e*n bloc* resection of the palmar annular ligament (PAL) (Technique 1); b) Resected PAL showing lesion in the undersurface of the PAL, following resection using Technique 1. An area of mineralisation present inside the PAL was protruding through the defect to impinge on the underlying SDFT.

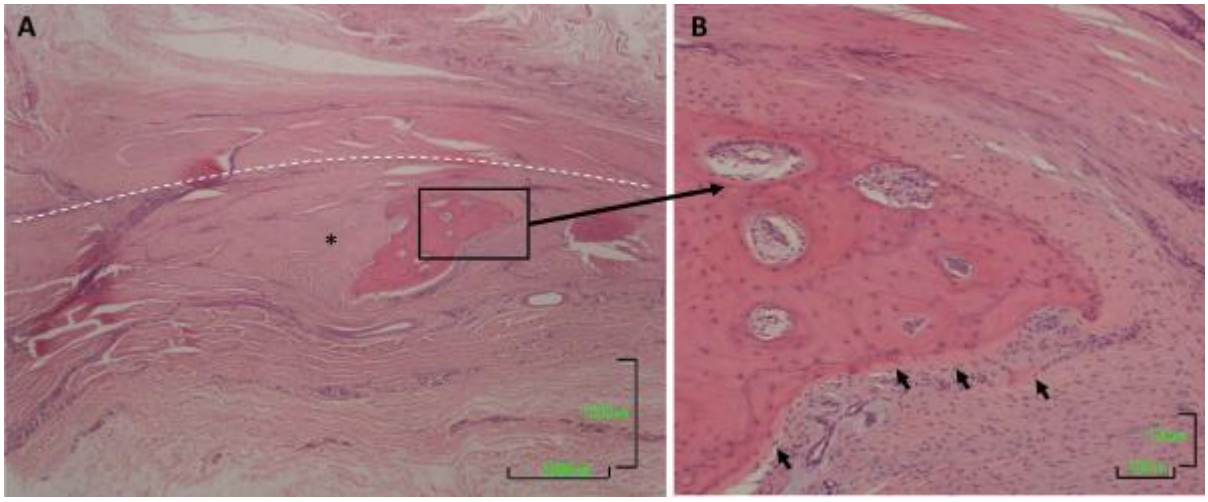

Figure 4. Excellent cosmetic appearance of limb (Technique 1) 6 months post-operatively (Case 8).