

Short- and long-term outcomes of primary Achilles tendon repair in cats: 21 Cases

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Keywords

Achilles tendon, Likert scale, tenorrhaphy

Summary

Objectives: To evaluate the short- and long-term outcomes of surgically repaired Achilles tendons in cats.

Methods: Twenty-one cats that underwent surgical repair of Achilles tendon injuries were retrospectively examined. Signalment, type of injury, time from injury to surgery, the surgical repair, complications, and long-term outcomes were recorded. Statistical comparisons were made between traumatic and atraumatic injuries using Student's paired t-tests.

Results: Both traumatic and atraumatic causes of disruption were equally represented and female cats were significantly over-represented. Type I and Type IIc injuries were found in cats, but the type did not affect short- or long-term outcome. A complication

rate of 33% was identified and was always attributable to the method of external coaptation. None of the cats that were augmented with a splint developed complications, however complications did occur in those with transarticular external skeletal fixators. Long-term clinical outcome found an 84% overall success rate and a 79% success rate for cats with Type IIc injuries. A significantly shorter time from injury to surgery was identified for traumatic injuries, but not for age, weight, or long-term outcome.

Clinical significance: Surgical correction resulted in excellent functional outcome in all cases but one, and should be considered in both complete and partial disruption of the Achilles mechanism in cats. A direct comparison between surgical and conservative management of Type IIc injuries in cats should be considered to determine which method is most appropriate to manage these injuries.

and also plays a minor role in tarsal extension. The anatomy of this mechanism is nearly identical in dogs and cats (1).

Although an uncommon injury, both partial and complete ruptures and avulsion injuries of the common calcaneal tendon have been reported in dogs and cats (2–7). A characteristic plantigrade stance with concurrent stifle extension is produced with complete ruptures, whereas partial ruptures lead to a lesser degree of tarsal hyperflexion. A claw-like appearance to the affected limb is noted if the GT and CT are ruptured but the SDF is spared (2, 5). Conservative management has been attempted but usually the results are unpredictable. Thus, surgical repair of the tendon in conjunction with immobilisation of the tibiotarsal joint has been advocated for the most consistent results and an appropriate return to function. Several techniques have been described for tendon repair including various suture patterns, free fascial grafts, tendon transfers, and the use of biological and artificial implants (5, 8, 9). Postoperative joint immobilisation is generally accomplished by casting or splinting (of varied configurations) with or without a calcaneo-tibial screw, or with a transarticular external skeletal fixator (4–6, 9–12). The literature supports a very good to excellent outcome with surgical repair by these methods in dogs, but there is a paucity of evidence regarding cats.

There is a single report in the literature of three cats with Achilles mechanism injuries, which consisted of two tendinoseous avulsions and a single calcaneal avulsion with a small bone fragment (3). Only the fracture was addressed surgically, while both tendinoseous avulsions were managed conservatively with external coaptation. Although the results in the short-term seem adequate, there is no data sup-

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Introduction

The Achilles tendon, also known as the common calcaneal tendon, is composed of three distinct musculotendinous components which converge and insert on the proximal aspect of the calcaneus. The three structures are the gastrocnemius tendon (GT), the superficial digital flexor tendon (SDF), and the combined tendon (CT) of

the gracilis, biceps femoris, and the semitendinosus muscle (1). The major component of this group, the GT, inserts on the proximal dorsal surface of the calcaneus and is responsible for extending the tarsus. The SDF inserts collaterally at the proximal calcaneus before continuing distally and attaching to the digits in the second row of the phalanges. The last component, the CT, inserts at the medial aspect of the calcaneus

porting the long-term outcomes of these patients. To the authors' knowledge, there are no reports in the veterinary literature addressing surgical repair of Achilles tendon injuries in cats. Thus, the objective of this report was to describe in detail the signalment, physical examination findings, type of injury, methods of surgical repair, and immobilisation techniques used for Achilles tendon injuries in cats in order to establish a categorisation and representation of Achilles tendon injuries in the cat. Additionally, this study also aimed to evaluate the short- and long-term outcomes of those surgical repairs to determine if surgical repair is successful in cats. Our hypothesis was that primary surgical repair of Achilles tendon injuries in cats would result in appropriate long-term functional outcome.

Materials and methods

A retrospective study was performed by searching computer based medical records by code to identify all cats that had undergone surgical repair of an Achilles tendon injury at two separate veterinary referral hospitals (Veterinary Surgical Associates and Alta Vista Animal Hospital) between 2000 and 2008. The diagnosis of Achilles mechanism injury was based on physical and radiographical findings alone in all cats. Signalment, body weight, history, type of injury, and time between injury and surgery were recorded. Cats were also classified as having a traumatic (open) or an atraumatic (closed) injury for the purpose of statistical comparisons. To determine if cats with atraumatic avulsions were obese, body weight was also recorded from a random population of cats in our database and a comparison between this population and cats with atraumatic avulsions was performed using Student's paired t-test. To avoid bias, people were chosen who had no association with this study and were instructed to randomly select cats from our entire patient database by patient number, therefore blinding them from the patients' weight. The patient number was used to access the medical record, their weight was then recorded, and the mean and standard deviation were calculated.

The technique used to surgically repair the damaged tendon, minor and major complications, and the methods of joint immobilisation were also noted. Minor complications were defined as any complication that did not require surgical intervention of any kind, whereas major complications did. Short-term outcomes were obtained by reviewing the medical records and noting any complications that occurred during the first 10 weeks. Long-term outcomes were evaluated in two ways. First, medical records were reviewed after the 10 week short-term follow-up period and any complications were recorded. Second, since force plate analysis was not available to us we attempted to use a questionnaire that had been previously validated in assessing mild to moderate lameness in dogs in a published study instead of making our own (13). A questionnaire has been used in many previously published studies, including at least two involving Achilles tendon repairs in dogs. We developed a Likert scale questionnaire comprised of 15 Likert-style questions based on the previously validated visual analog scale (VAS) questionnaire where the wording of some questions was only slightly modified to better represent cats' daily activities as opposed to a dog (13). The clients were instructed to circle a numeric value assigned to each question ranging from 1 to 5, with 1 being the lowest score, and 5 being the highest. Occasional items were reversed in meaning from the overall direction of the scale (reversal items) and the response value was reversed for each of these items before summing for the total. That is, if the respondent circled a 1, it was scored a 5; if they responded 2, it was scored a 4 (3 = 3; 4 = 2; and, 5 = 1). The final score for the respondent on the scale was the sum of their ratings for all of the items with a maximum cumulative score of 75. This allowed for an objective assessment of the questions, and thus, the clients' perspective on the overall success of the surgery. To be considered long-term, the patient must have had surgery performed a minimum of six months prior to the start of the study. If patients were deceased at the time of the study, their time to follow-up was measured as the time from surgery until death or euthanasia.

The mean and standard deviation were calculated for age at surgery, weight, the time between the incident and surgery, and the sum of the Likert scale questionnaire for the study population, and between cats with traumatic and atraumatic injuries. Comparisons between traumatic and atraumatic injuries were made using Student's paired t-test^a and a p-value of <0.05 was considered significant.

Results

During the eight-year-period at the referral hospitals, twenty-three cases of Achilles tendon injury were identified in cats. Of those, two were initially excluded as review of the medical records confirmed avulsion of the origin of the gastrocnemius muscle. Of the remaining twenty-one cases, all had sufficient data to be included in the initial part of the study. Breed distribution for the 21 cats was predominantly Domestic Shorthair (n = 20), with the only purebred represented by a Persian. Mean age at the time of surgery was 10.47 ± 5.17 years (range: 2-19) and mean weight was 5.07 ± 1.10 kg (range: 3.18-7.27). Surprisingly, there was a 6 to 1 ratio (18 to 3) of females to males represented in this study, none of which were intact but the time of ovariohysterectomy or castration was not consistently noted in the records. Right and left Achilles tendon injuries were more or less equally represented (10 left, 11 right). A plantigrade stance and soft tissue swelling of the affected tarsus was evident in all cats except for two cats that had partial GT avulsions and an intact SDF. These cats demonstrated only a mild increase in flexion of the hock.

Thirteen of the cats lived solely as indoor pets. Of these, seven out of 13 (54%) did not have any external evidence of trauma. This included the single cat which had a chronic non-healing ulcer on the caudal aspect of the calcaneus; the cause was thought to be the result of repeated trauma of the calcaneus on the tissues due to an undiagnosed chronic Achilles mechanism

^a Microsoft Excel, 2003: Microsoft Corporation, Redmond, Washington, USA

rupture. The remaining six all had open injuries and resultant traumatic lacerations. Of those, the cause of the trauma was unknown in three and assumed to be caused by broken glass objects found in the house in the other three. Eight cats had access to the outdoors. Of these, four out of eight did not have an open injury while the remainder had evidence of a traumatic incident. These included being bitten by a dog ($n = 2$), chased by a dog resulting in trauma ($n = 1$), and a gun shot wound ($n = 1$). Thus, a cats' living conditions had no direct effect on the number of traumatic or atraumatic Achilles tendon injuries.

Eight cats (38.1%) had an acute injury (time between injury and surgery <48 hours), 11 cats (52.4%) had subacute injury (time between injury and surgery ranged from 2 to 21 days), and 2 cats (9.5%) had a chronic injury (time to surgery > 21 days). The average number of days between the onset of lameness or evidence of injury and referral to our hospitals for surgical evaluation was 9.48 ± 12.89 days (range: 1-45) for all cases. Evaluated separately, in cases where there was evidence of trauma, the mean number of days to admission decreased to 3.4 ± 5.46 days (range: 1-18) whereas those without evidence of trauma increased to 15.0 ± 15.34 days (range: 1-45). There was a significant difference in the mean time to admission between traumatic and atraumatic injuries ($p = 0.036$). Three distinct types of Achilles tendon injuries were identified in this report. There were 14 tendinosseous avulsions (66.7%) which included two that were partial in nature (~80% torn), five mid-tendon lacerations (23.8%), and two distal lacerations (9.5%) that resulted in complete disruption of the Achilles mechanism and required surgical repair identical to an avulsion. Regarding the avulsions, 11 out of 14 (78.6%) were atraumatic avulsions being that no evidence or history of trauma was noted, while the remaining three were caused by known traumatic incidences. Physical examination was consistent with GT and CT avulsion while sparing the SDF in nine out of 11 atraumatic tendinosseous avulsions. Only one out of 11 cats in this study with non-traumatic avulsion was or ever became bilaterally affected, and of the 17 cats that we obtained long-term follow-

up information from, none were ever presented with a contralateral injury.

When analysing the atraumatic avulsions, a mean weight of 5.40 ± 1.25 kg (range: 3.18-7.27) and a mean age of 12.2 ± 3.67 years (range: 6.5-16) were calculated with respect to known traumatic injuries, a mean weight of 5.70 ± 0.82 kg (range: 3.85-6.00) and a mean age of 8.6 ± 6.08 years (range: 1.5-19) were calculated. There was no significant difference in mean age ($p = 0.11$) or mean weight ($p = 0.16$) between cats that had traumatic injuries and those that had atraumatic avulsions. Additionally, the mean weight of our randomly sampled population ($n = 100$) was 4.92 ± 1.56 kg (range: 2.27-9.59) and was not significantly different ($p = 0.23$) than those cats with atraumatic tendinosseous avulsions. It is also worth noting that 10 out of 11 atraumatic avulsions (90.9%) were spayed females.

Surgical repair of the damaged Achilles tendon was performed using a lateral or caudo-lateral approach to the area with debridement of any fibrous, frayed, or damaged tendon ends to the level of healthy tissue. In all cases of avulsion, and both cases of distal laceration, the free tendon end was apposed to the calcaneus. This was accomplished by drilling one or two bone tunnels in a medial-lateral direction in the proximal calcaneus using a 1.5 mm drill bit and the securing the tendon with suture. In mid-tendon lacerations, the tendon ends were debrided and reapposed. Polypropylene^b suture of various sizes was used in every case ranging from 2 to 3-0, with 0 being used most commonly (10 out of 22 cats). Suture patterns used were either a locking loop ($n = 3$) or 3-loop pulley ($n = 2$) for all mid-tendon lacerations and a modified locking loop ($n = 15$) or modified 3-loop pulley ($n = 2$) for all avulsions and distal lacerations. In half of the surgeries, ancillary support was provided by the addition of sutures of varying patterns placed between the tendon ends or between the tendon and the calcaneus. Routine closure of the remaining tissues was performed and the tarsus was immobilised in conjunction with surgery. A type-II transarticular skel-

etal fixator (TESF), was used in 16 cats and was constructed using metal connecting bars ($n = 7$), polymethylmethacrylate or acrylic ($n = 5$), circular ring fixators ($n = 2$), or a type-I TESF in conjunction with a Rudy boot was used ($n = 2$). In a single case, a calcaneo-tibial orthopaedic wire was used to immobilise the tarsus along with a fibreglass cast. Of the remaining five cats with a splint or cast placed, there were two with a bivalved fibreglass cast, two with a medially placed splint fashioned out of thermoplastic^c, and one with a lateral fibreglass splint. All methods of external support were placed with the tarsus in slight extension, at approximately 145° . External support remained in place from four to nine weeks followed by a decrease in the degree of support to a soft padded bandage in 11 of the cases, for one to three weeks. All patients were discharged with appropriate medications for pain management, and all but two were prescribed antibiotic medications postoperatively.

In the short-term, 15 of 21 (71.4%) cats had no complications at all, three (14.3%) had minor complications, and three (14.3%) had major complications, for a total short-term complication rate of 28.6%. The minor complications consisted of: 1) breakdown of an acrylic connecting bar on a type-II TESF four weeks postoperatively, which was replaced without incident; 2) Pin-tract drainage evident at suture removal, which developed into a pin-tract infection at four weeks postoperatively requiring antibiotic therapy; 3) Breakdown of an acrylic connecting bar on a type-I TESF one day postoperatively with subsequent failure of the construct four weeks postoperatively. The TESF was removed and the cat had no additional complications. The major complications consisted of: 1) Failure of a two-pin type II TESF two weeks postoperatively and which resulted in opening of the surgical incision and failure of the tenorrhaphy; 2) Failure of an acrylic type-I TESF six weeks postoperatively which resulted in repair failure; 3) Severe swelling and purulent exudate at the surgical site with radiographic evidence of a calcaneal fracture through a pin hole of a

^b Prolene: Ethicon Inc., Somerville, NJ, USA

^c Orthoplast: BSN Medical Inc., Charlotte, NC, USA

type-II TESH four weeks postoperatively, although the tenorrhaphy was intact. All short-term complications were generally a result of the immobilisation technique and not directly related to the repair itself, and none of the cats that had external coaptation ($n = 5$) ever developed a minor or major complication. Only a single case encountered a complication with the repair itself and which did not manifest in the short-term. That cat developed a sinus tract seven months postoperatively which was managed with long-term antibiotics after culture and sensitivity diagnosed a *Pseudomonas* infection. The infection did not resolve with medical management alone and since healing of the tendon was complete at that time, the polypropylene sutures were removed and the cat did not develop any further problems. Including this cat, 14% minor (3 out of 21 cats) and 19% major (4 out of 21 cats) complications were encountered for a total complication rate of 33% (7 out of 21 cats).

Of the 21 cats in the study, long-term follow-up was available for 18 patients. We were able to contact 17 of the clients, three were lost to follow-up, and one patient's long-term outcome was reviewed in the medical records, and the owners were not sent a questionnaire. The average time to follow up was 2.37 ± 1.54 years (range: 1-6). Seven of the 18 patients were deceased at the time of the survey and only one of those patients was euthanized due to their Achilles tendon injury. The mean age of cats that were deceased at long-term follow-up was 13.13 ± 3.51 years (range: 7-16.5); these cats died an average of 2.79 ± 2.15 years (range: 1.08-6) after surgical correction. The questionnaire produced an average score of 62.9 out of 75 as a cumulative score, which was interpreted as a successful long-term outcome in 84% of all of the cases. Of the cats that had tendinoseus avulsions with no known cause, the average cumulative score was 59.0 ± 13.3 out of 75 (range: 23-71), which resulted in a 79% success rate in functional outcome. When only looking at cases that had an intact SDF similar to the two cats treated conservatively in a previous study, the average score was 58.8 out of 75, which calculates into a long-term functional success in 78% of the cases. Also, cats with traumatic

causes of Achilles mechanism disruption received an average score of 67.2 ± 4.2 out of 75 (range: 62-71) which translated into a 90% overall success rate. There was no significant difference in long-term outcome between cats with traumatic and atraumatic Achilles tendon injuries ($p = 0.10$). Lastly, when evaluating the individual numeric scores to the Likert items, 82% of all responses were scored either 4 or 5, indicating that a large majority of the clients perceived a long-term success of the surgery.

Discussion

Achilles tendon injuries remain an uncommon condition in companion animals and although there are several reports in dogs, there is only one study published in 1994 about cats (3-7, 9-12). In that study three cats were evaluated; only one of which had an avulsed bone fragment reattached surgically. The remaining two were diagnosed with bilateral tendinoseus avulsions with an intact SDF and were conservatively managed with external coaptation consisting of fibreglass splints for six weeks (3). It was suggested that the aetiology of Achilles tendon rupture was most likely traumatic, although no evidence existed in any case. With such a small sample size, it is difficult to infer any predisposing factors, aetiologies, categorisation of the injuries, or the need and success of surgical repair. Our sample size of 21 cats was much larger and allowed for evaluation of several factors that might contribute to these injuries and for categorisation of the injuries themselves.

Based on a classification system of canine Achilles tendon injuries developed by Meutstege, a complete tendon disruption is categorised as a Type I injury, while partial avulsions with the SDF intact are Type IIc injuries (14). In the present series, Achilles tendon injuries encountered in cats were as follows: 1) complete (Type I) tendon rupture which included all avulsions, mid-tendon or distal tendon lacerations, and partial (Type IIc) avulsion of the tendon at the tendinoseus junction. Type IIa, IIb, and III injuries, as well as avulsion fractures that are seen in immature animals associated with incomplete ossification of the calcaneal growth plate at the site of tendon insertion were not

encountered in our study (14). Known traumatic incidences were responsible for 48% of all injuries which caused all mid-tendon lacerations ($n = 5$), tendinoseus avulsions ($n = 3$), and distal lacerations ($n = 2$). The remaining 52% without evidence of trauma had tendinoseus avulsions.

In humans, several studies have suggested that spontaneous tendon ruptures are attributable to repeated stress causing chronic wear and degeneration in the microstructure of the tendon itself (15). The presence of tendon degeneration at the sites of tendon rupture at time points very soon after rupture suggests that degeneration is not a secondary event, and it is now generally accepted that tendon degeneration causes the rupture and does not result from it (15). This theory was supported in dogs by Guerin et al who observed four out of five dogs with Achilles tendon injuries that were large breed working dogs, including three that had bilateral ruptures (9). Additionally, histopathological evaluation of avulsed tendon ends in dogs has demonstrated fibrovascular proliferation adjacent to reactive bone, further strengthening this theory (9). Although this may be the same mechanism causing rupture at the tendinoseus junction in cats, histopathology of the damaged tendon ends was not undertaken in our study to verify this. If chronic wear and tear were the mechanism of tendon rupture, one would have expected a much higher percentage of cats in this study to be affected in both pelvic limbs at some point. Another suggested predisposing factor in both people and dogs includes the use of high doses of corticosteroids and fluoroquinolones (16, 17). Only a single cat was being administered long-term corticosteroids for the treatment of immune-mediated haemolytic anaemia at the time of the injury and none were being administered long-term fluoroquinolones. The corticosteroids may have been the cause of the cat's avulsion but the dose being administered was considered appropriate and makes this less likely. The injury is also commonly seen in older women, and is suggested to be due to postmenopausal osteoporosis and gradual degeneration and weakening of tendons as part of the normal aging process. The population of cats affected in our study was predominantly females (86%) and when only considering those with atrau-

matic tendinoseus avulsions, 91% were females with a mean age of 12.2 years. It is impossible to ignore the predisposition for geriatric females with this injury in our study, but with a sample size of only 21, any conclusion is less powerful. Conversely, female predilection may not be evident in dogs. A total of 67 cases of tendinoseus injuries in six previous studies identified 36 females and 31 males. With an almost equal representation, it is unlikely that any sex predilection exists in dogs (4, 6, 9, 10, 12, 18).

Obesity, along with a sedentary lifestyle, has also been implicated. Unfortunately, body condition score was not consistently recorded to obtain an objective assessment of the cats' condition. The mean weight of cats with atraumatic tendinoseus avulsions in our study (5.4 kg) was not significantly different from the random sample of our hospital population. Therefore, cats with tendinoseus avulsions were not considered to be obese in comparison to the general population making body weight an unlikely causative factor. In general cats lead a very sedentary lifestyle with intermittent periods of activity, but whether this leads to disuse and subsequent degeneration of the Achilles mechanism is not known.

The only study in cats suggests that surgical fixation is not necessarily warranted if Achilles tendon avulsion at the tendinoseus junction occurs (3). In those three cats, physical examination was consistent with GT and CT avulsion while sparing the SDF, but no injuries were encountered that caused complete disruption of the Achilles mechanism. In our study, 12 cats had injuries that were deemed necessary surgical candidates as complete tendon disruption occurred. Of those 12, only two were atraumatic tendinoseus avulsions and the remainder were associated with a traumatic event. The other nine atraumatic avulsions fell into the same category as the aforementioned study with GT and CT avulsion and an intact SDF tendon. Unlike that study in which only external coaptation was performed to address the rupture, all nine of our cases were surgically repaired. It is thought that after any type of avulsion, without surgical apposition, contracture of the gastrocnemius muscle would pull the ruptured tendon proximally creating a significant defect between the tendon and the

bone. As one of the main determinants of adequate healing is the prevention or minimisation of gap formation at the tendon ends, it thus seems unlikely that tendon healing would occur without reapposition (2, 5). Gaps produce distraction of the tendon ends, which decreases local blood supply and increases the amount of fibrosis, and thus produces an environment that would adversely affect tendon healing and the final function (2, 5, 19). The decision to surgically address our cases was based on these premises and that apposition of the tendon to bone would produce predictable results similar to those seen in dogs. The lack of any surgical reports in cats, the minimal data in the literature regarding conservative treatment, and inadequate healing, poorer postoperative function, and unpredictable results seen in dogs with conservative treatment alone were also deciding factors.

Surgical fixation was successfully accomplished in all of our cases using various suture patterns and methods of immobilisation. Both locking loop and 3-loop pulley suturing techniques were used in traditional and modified manners depending on the type of injury. Several reports have shown that the 3-loop pulley suture pattern can withstand greater forces before gap formation during loading and has a significantly greater maximum load than one or two locking loops, which suggests that it is a superior suture pattern in the repair of tendinous injuries (20–25). Although a single locking-loop pattern was used in the majority of our cases, none of the Achilles tendon repairs failed at the surgical site. In the two cases in which the tenorrhaphy broke down, both were repaired with a locking-loop pattern, but failure occurred in the early postoperative period secondary to a complication with tarsal immobilisation, and was not attributable to the suture pattern chosen. It is worth noting that there were other TESSF failures that did not result in breakdown of the tenorrhaphy, and which were also repaired with a locking-loop suture pattern. None of the Achilles tendons that were repaired with a 3-loop pulley failed, but the form of external support was not compromised in any of these cases. Even though the sample population was small, this may indicate that both suture patterns are an acceptable choice in

counteracting the forces placed on the repaired Achilles mechanism of the cat and thus prevent gap formation. It should be noted that all repairs were supplemented with some method of tarsal immobilisation, which was not taken into consideration in any of the studies evaluating suture pattern, gap formation, and maximum load at failure (20–25). This suggests that as long as the method of immobilisation remains intact and is placed in an appropriate manner with the tarsus in slight extension to allow initial tendon healing, breakdown of the primary repair is unlikely regardless of the pattern used for apposition.

Complication rates following surgical repair of Achilles tendon injury has not been previously reported in cats. Although minor complications had no effect on the clinical outcomes, they were not excluded from calculation of the complication rate since they required some level of intervention to ensure that the primary repair was sustained. With regard to the major complications, in two cases the tendon was repaired in a similar manner as the original surgery, except external coaptation was performed with a lateral fibreglass splint and soft padded bandage instead of replacing the TESSF. Both cats went on to heal without further complications. In the third case, the calcaneal fracture was repaired with pins and a tension band and external support accomplished with a bivalved fibreglass splint and soft padded bandage. This patient subsequently developed osteomyelitis at the site of calcaneal fracture repair. The cat was presented eight months after the original surgery with similar clinical signs in the contralateral limb, and was diagnosed with avulsion of the Achilles mechanism and subsequently euthanized due to a poor prognosis given the outcome of the first repair. The results of our study agree with those in dogs with a relatively high complication rate, and except for a single long term complication that resulted in infection, all complications resulted from the method of tarsal immobilisation and not the repair itself. Since all complications were identified in patients that had a TESSF placed, this would suggest that external coaptation is a more appropriate method of immobilisation than a TESSF. A more recent study evaluating the use of a

single-ring TESH for talocrural joint immobilisation found excellent functional outcomes and periarticular swelling as the most common complication (18). Although this method has not been evaluated in cats, it is possible that with a smaller construct that does not require pins being placed in the metatarsal bones, the complication rate with TESH in cats might improve. In dogs, the method of immobilisation did not significantly affect the complication rate or final functional outcome (10). Unfortunately, given the variance in the type of TESH and splints placed, the small sample size, and small number of complications, it is impossible to compare the two directly to make the same conclusion.

Assessment of lameness was not performed in a clinical setting beyond the six to 10 week postoperative examinations, and thus to ensure successful outcomes occurred, long-term follow up by client communication was deemed an essential part of the study. The Likert scale was chosen for our questionnaire since it is a scoring system that allows the person being surveyed to quantify their responses with a summation representing an overall score. The 15 questions were obtained from a canine movement assessment survey that was constructed as a visual analog scale (VAS) questionnaire and developed by Hudson et al in 2004, in which clients were asked to evaluate pain and lameness in their dogs. This questionnaire was meant to determine the degree of lameness when force plate examination was unavailable (13). We did not solely use this questionnaire since three of the questions addressed the animal's lameness in the one-month period preceding clinical evaluation, which would not fit our sample population. Although there are studies proving kinetic gait analysis is the standard for objectively measuring ground reaction forces in the pelvic limbs of cats, we believed that this survey is likely an accurate representation of an owners ability to determine if their own pet is clinically lame or not and thus, surgical outcome.

There are limitations to our study, mainly stemming from its retrospective design which in itself limits the conclusions that can be made from the results. A major limitation was the evaluation of long-term outcomes using a subjective, partially vali-

dated questionnaire. Kinetic gait analysis would have resulted in objective data, but was beyond the scope of this study and was not available at our hospitals. Moreover, clients are less likely to have their pets re-evaluated if they are doing well clinically and not all patients were alive at the time of the study. Additionally, several comparisons were made between groups that had traumatic and atraumatic injuries. Although open injuries prove there was evidence of trauma, the lack of an injury does not completely rule it out, and thus, classification into these two groups could be considered somewhat of an assumption.

In conclusion, our results suggest that surgical correction of all forms of Achilles mechanism injuries in cats resulted in successful functional outcomes. When compared to cats with tendinoseous avulsions and an intact SDF, a slightly higher functional outcome was obtained in cases that had complete disruption of Achilles mechanism in which conservative management was not an option. Although complications were encountered, the type encountered and the complication rate was similar to that seen in dogs. Besides an over-representation by females, no other factor could be identified as a distinct causative agent. Finally, a direct comparison between conservative management of partial Achilles tendon rupture with external coaptation and surgical correction was not made. With an appropriate sample size of each, determination of the most appropriate method of management could be made in future studies.

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