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FOUR LEG NEWS



The Digit Issue

This issue of FourLeg News is about digit injuries. The articles I could find were predominantly about the flexor digitorum profundus tendon (deep digital flexor tendon) and repairs. So that's what you've got, with an assortment of other papers: PIP instability; lasers and atopic dermatitis; and escalator-related digit injuries. Enjoy the read!

Cheers, Laurie

When to start rehab after surgical ligament repair

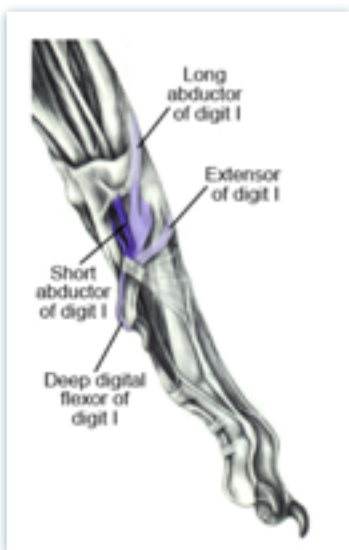
Zhao, C., Amadio, P., Paillard, P., Tanaka, T., Zobitz, M., Larson, D., An, K., Digital resistance and tendon strength during the first week after flexor digitorum profundus tendon repair in a canine model in vivo, *The Journal of Bone and Joint Surgery*, 86-A(2), pp. 320-327, 2004.

Postoperative rehabilitation of tendon repair with either passive or active mobilization is an important part of recovery from tendon injury. However, if the force required to overcome resistance of the digit to motion is greater than the force the tendon can withstand at any stage of healing the tendon will rupture.



Objective

To determine the period of time, in the first week following surgery, that would be the safest to initiate either active or passive mobilization of the repaired tendon.



Methods

48 medium-sized dogs were selected. Each dog had two flexor digitorum profundus (FDP) tendons exposed surgically. One of these tendons was surgically lacerated then repaired, the other was closed up after exposure without laceration (a sham tendon). All joints were immobilized. Dogs were randomly placed in one of four groups to be sacrificed and have the tendons harvested at either day 1, 3, 5, or 7. Four tendons from each subject were harvested for testing, the repair tendon, the sham tendon, a suture strength test tendon, and an untouched control tendon.

Proximal and digital load transducers were used to record the forces applied to the tendons during testing. The force required to overcome friction between the tendon and sheath was

calculated as peak gliding resistance. The force to move the digit was calculated as peak digital resistance. The sum of these forces is the total digital resistance force.

Force was applied to tendons until they ruptured.

Results

Day five showed the lowest total digital resistance. Gliding resistance was still significantly higher in the repair tendons than in the control or sham tendons at day 5, but the reduction in digital could account for the reduction in total digital resistance, likely due to a decrease in swelling and inflammation between days 3-5. The total resistance and the gliding resistance increased again at the 7 day mark, likely due to adhesion formation and possibly as a factor of immobilization of the joint for a week.

These results would suggest that it would be safest to start mobilization (whether active or passive) of the tendon at the 5 day mark following surgical repair, when the resistance forces are at their lowest, and therefore the risk of rupture is reduced.

Thoughts: So, I guess the conclusion speaks for itself. If you need to treat a tendon repair, start at day 5.



External fixation for PIP instability

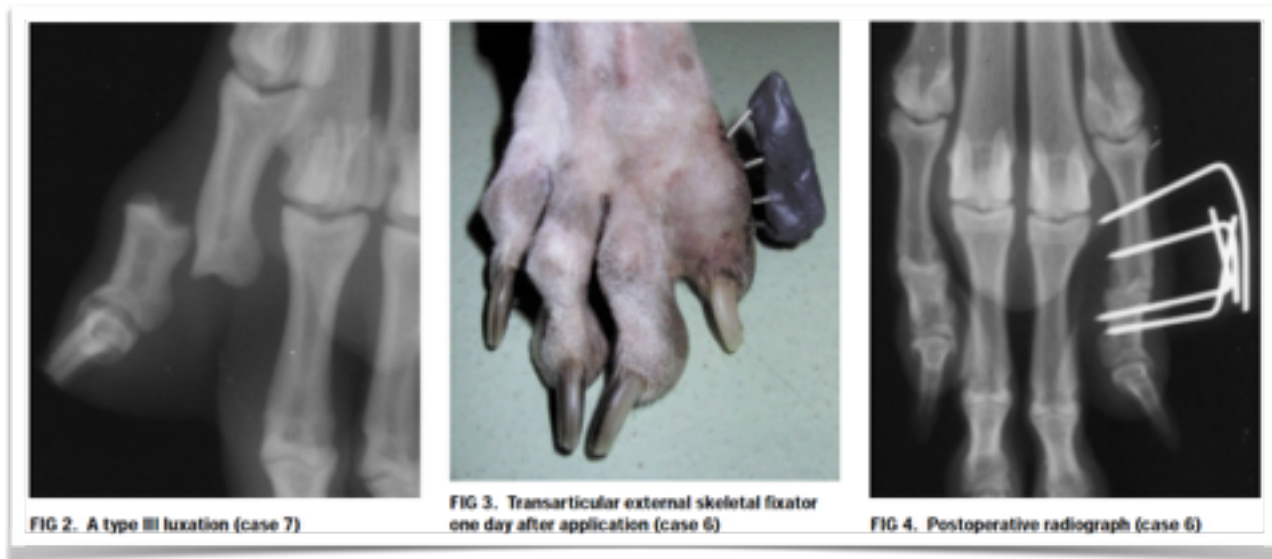
Guilliard, M., *Proximal interphalangeal joint instability in the dog* *Journal of Small Animal Practice*, 44, pp. 399-403, 2003.

Objective

To determine if transarticular external skeletal fixation can be used to treat proximal interphalangeal joint instability caused by type II and III sprains resulting in partial or complete luxation of the interphalangeal joint. The hypothesis is that external fixation of the joint can allow fibrosis to restore joint stability.

Methods

10 cases, 9 of which were sighthounds and included racing dogs, coursing dogs, and domestic pets, were treated with a transarticular external skeletal fixator attached to the first and second phalanx. Pins were removed between 18 and 34 days after fixation.



Results

Initial results showed full recovery of function in all 10 dogs. One dog, a racing greyhound, suffered a recurrence of the injury after returning to the track. All other track greyhounds and coursing hounds in the study returned to their previous activities with no problems. 6 of the dogs received follow-up examinations, and reduced range of motion was found in 5 of these dogs but was not associated with a significant loss of function as reported by the owner.

Thoughts: Well, this is great! However, I think that using an external fixator on a PIP instability just might be overkill. There are plenty of sporting dogs with ligamentous damage to their digits, and I have yet to see any of them require this degree of stabilization. Rest from activity should also allow fibrosis to set into the joint and act as a stabilizer.

The benefits of low grade movement on tendon repair

Hitchcock, T., Light, T., Bunch, W., Knight, G., Sartori, M., Patwardhan, A., Hollyfield, R., *The effect of immediate constrained digital motion on the strength of flexor tendon repairs in chickens* The Journal of Hand Surgery, 12(A), pp. 590-595, 1987.

Objective

To determine the effect of immediate constrained digital mobilization on the strength of a digital flexor tendon repair during the initial stages of healing in the first 3-12 weeks following repair.

Methods

216 chickens were surgically given flexor profundus tendon lacerations on the central toe. The lacerations were then repaired using one of either a 4-0, 5-0, or 6-0 polytetrafluoroethylene (PTFE) modified Kessler suture and a running epitendinous 6-0 Prolene stitch.

Animals were then randomly placed into one of two groups for post-op care. In both groups the medially and lateral toes were pulled into hyperextension to reduce tension on the repaired toe, which remained in normal extension. In the immobilization group the toes were put into a fiberglass cast in this position. The cast remained on until the tendon was harvested for testing. In the mobilization group the central toe was covered in a sterile and flexible dressing and the medial and lateral toes were held in hyperextension by rubber band tethers. These chickens were allowed to walk and step on objects in their enclosures that caused intermittent passive flexion and extension of the toe.

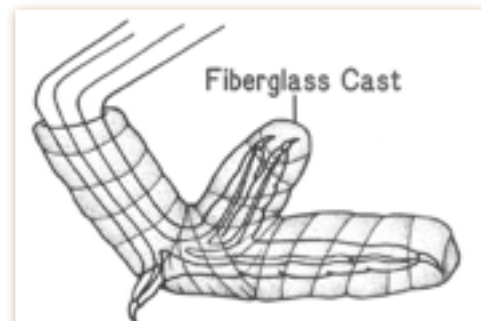


Fig. 2. Hyperextension cast technique.

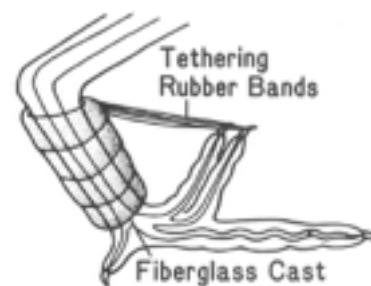
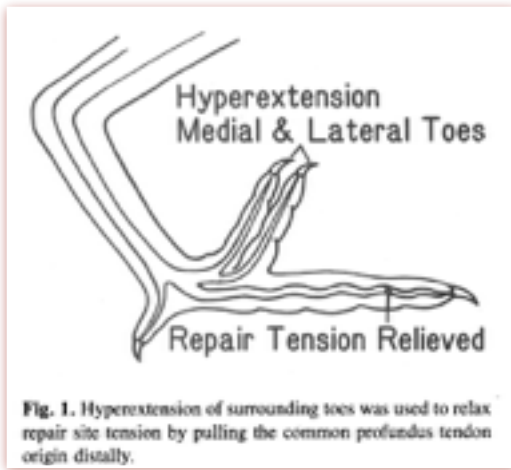


Fig. 3. Mobilization splint technique. The tension of the rubber bands was adjusted to tether the surrounding toes in constant hyperextension.



At intervals of 0, 5, 10, 15, 20, 30, and 40 days six chickens from the immobilized group and five chickens from the mobilized group were sacrificed and their repaired tendons harvested for testing. Tests included measurement of tendon gaps, and edema and adhesion were graded on a 0-3 scale. A tension stress test was used to test the rupture strength of each harvested tendon.

Results

Suture strength itself only significantly affected the rupture strength of the tendon at day 0. After that point there was no significant difference in tendon strength in relation to suture strength.

Tendons that were immobilized after repair decreased in rupture strength from day 0 to day 20. At the 30 and 40 day intervals rupture strength had increased, but never reached the rupture strength that was measured at day 0.

The tendons in the mobilized group showed immediate progressive gains in rupture strength at each interval and the difference in strength between the two groups was significant ($p < 0.05$) at just the 5 day interval. As healing progressed, the differences became more pronounced. By 40 days the tendon strength in the mobilized group was 27% - 32% that of the uninjured tendon.

Ruptures of the tendons occurred only in a small group of chickens where the rubber bands holding the medial and lateral toes in hyperextension broke, suggesting that the hyperextension of those toes was critical for protection of the repaired tendon.



This study concludes that tendon softening and the initial loss of tendon strength seen in the early healing stages of immobilized tendons following repair can be avoided with constrained mobilization immediately following surgery.

Thoughts: Okay, so this is a strange study. I played around with my own fingers to try to work out why hyperextending the medial & lateral digits would have any effect to protect the centre digit. What it feels like to me, is that the centre digit would flex in response. Anyways, it's interesting because it looks like low grade movement (not to end range) is beneficial for healing of a surgically repaired tendon, and better than immobilization.



The effect of elbow position on tendon tension

Tanaka, T., Amadio, P., Zhao, C., Zobitz, M., Kutsumi, K., An, K., *Effect of elbow position on canine flexor digitorum profundus tendon tension* Journal of Orthopaedic Research, 23, pp. 249-253, 2004.

Canine models are sometimes used to study the effects of tendon injury and treatment in humans. When it comes to injuries to the flexor digitorum profundus (FDP) tendon a significant anatomical difference between the origin point of this muscle in the human (on the forearm) and in the dog (the

medial epicondyle of the humerus) may result in observed inconsistencies and variabilities in the results of the canine model.

Objective

To determine the effect that elbow position has on the canine FDP tendon tension, and how this should be taken into consideration during the rehabilitation process.

Methods

Seven forelimbs were harvested from previously sacrificed medium sized adult mixed breed dogs. The FDP tendon of the second digit was exposed and marked in two places and attached to a pulley able to measure Newtons of force applied to the tendon.

Testing was done with variation in manipulation of elbow, wrist, and digits through the entire range of motion. Force data was collected and analyzed via the transducer by computer during the testing.

Results

Elbow position showed a large effect on tendon tension for all combinations of wrist and digit position.

1) Tendon tension was highest with the elbow fully flexed, and decreased as the elbow was extended through 90 degrees, and the tension at 90 degrees flexion was still significantly higher than when the elbow was in full extension.

2) Wrist position showed a large effect on all digit positions, with flexion of the wrist at 90 degrees showing significantly less tension than with the wrist extended.

3) Metacarpalphalangeal (MCP) extension increased tension on the tendon, but if the MCP was fully flexed, no elbow or wrist position created any force on the FDP tendon.

The greatest forces across the board were observed when the elbow was in flexion. It has been common practice to immobilize the canine elbow post operatively in flexion, as it is common practice to do so in human patients. However the variation in anatomy of the FDP tendon in dogs, and the results of this study, suggest that doing so puts the greatest level of stress on the FDP tendon.

Thoughts: So the information above is ‘common sense’ if you have ever tried to stretch the Deep Digital Flexor Tendon (aka Flexor Digitorum Profundus). It also give you a more structured way to know how to stretch the DDFT: Elbow flexion, Carpal extension, MCP extension, and then finally extend the digit.



Laser for Itchy Toes

Stich, A., Rosenkrantz, W., Griffin, C.,
Clinical efficacy of low-level laser therapy on localized canine atopic dermatitis severity score and localized pruritic visual analog score in pedal pruritus due to canine atopic dermatitis *Veterinary Dermatology*, 25, pp. 464-e74, 2014.

Canine atopic dermatitis is a genetic, chronic inflammatory and pruritic skin disease associated with the overproduction of IgE antibodies (allergic reactions). It is the second most common allergy related skin disease in dogs. Topical and systemic treatments are available, however the condition often requires a multimodal approach in treatment and management.

Objective

To explore the effects of low-level laser therapy (LLLT) on the severity of localized canine atopic dermatitis on the paws.

Methods

Client owned dogs with a history of strictly seasonal pruritis were used, and since each dog would serve as its own placebo control either both front feet or both hind feet were required to be affected. If all four feet were affected, the most severely affected pair (front or back) were used for the study.

Dogs were required to eat the same diet, and if taking concurrent medications for treatment of the atopic dermatitis must not have had a change in drug or dosage for a minimum amount of time leading up to inclusion in the study.

Dogs were divided into two groups, where one group received LLLT on the left paw and placebo on the right, and visa versa for the second group.

A CTC Companion Compact laser (12W max. Power dual wavelength of 980 nm and 810 nm with a 650 nm aiming beam) was used for the test paw, while the placebo paws were treated with an aiming beam only. Treatments provided a standard dose of 4J/cm² and covered the area from the carpus/tarsus to the distal aspect of digit 3). Treatments were received three times a week, not on consecutive days, for week 1 and 2, and twice a week for weeks 3 and 4. Scores were collected in week 5, when no laser treatments were received.

Results

- 1) There was no significant difference in the local canine atopic dermatitis severity score or in the local pruritic visual analog score between laser treated and placebo treated paws.
- 2) But there was a statistically significant improvement in both paws over the 5 weeks, likely due to a placebo effect.
- 3) It cannot be ruled out by this study whether a systemic effect of LLLT may have contributed to the improvements in both paws.

Thoughts: Interesting! So, I don't think that 'placebo effect' would have this effect in dog. I would buy that perhaps there is a systemic effect to laser. Moreover, perhaps the laser dose was too high (although I don think 4J/cm² is unreasonable), or perhaps the wavelength is less than ideal (wavelengths in the 600nm range are better for skin). Or perhaps the benefits to BOTH feet came from the 650nm aiming beam - which is what was used alone on the control foot. The whole study simply makes me go hmmm.



A different kind of toe biting

How One Man Learned He Had Diabetes

<http://abcnews.go.com/Health/Diabetes/dog-eats-toe-man-diabetes/story?id=11322244>

By COURTNEY HUTCHINSON - ABC NEWS MEDICAL UNIT Aug. 4, 2010

Most pet owners would be irate if their dog bit off one of their toes, but Jerry Douthett, of Rockford, Mich., is nothing but grateful: this canine feat may have saved his life.

Douthett was alerted to the seriousness of a bone infection in his foot, resulting from previously undiagnosed Type II diabetes, when his terrier Kiko bit off his big toe while he was passed out drunk, according to The Grand Rapids Press.

"Jerry had had all these Margaritas, so I just let him sleep," his wife, Rosee, a registered nurse told the Michigan paper. "But then I heard these screams coming from the bedroom, and he was yelling, 'My toe's gone, my toe's gone!'"

He suspected for months something was wrong with his foot, but the 48-year-old musician had only recently scheduled an appointment to see a doctor.

Douthett was rushed to the hospital by Rosie where doctors amputated the rest of his toe and diagnosed him with Type II diabetes.

Though Kiko is being hailed as a hero, he is also being watched by authorities to ensure that he doesn't have rabies.

But a dog wouldn't need to be rabid to act in the way Kiko did, according to Brian Adams, spokesperson for the Massachusetts Society for the Prevention of Cruelty to Animals-Angell.

When flesh begins to die, as would have happened with Douthett's infection in his toe, it lets off a particular odour that any dog can be attracted to.

"Dogs are known to be attracted to licking wounds. It wouldn't be a bridge too far to suppose that the toe would have given off an odour that attracted the dog, and that may have progressed to biting or gnawing on the toe," he says.

"If the owner didn't wake up, there'd be no deterrent to stop."

The fact that Kiko's owner most likely had elevated blood sugar due to his diabetes would have made the appeal all the stronger, says Dr. Marty Becker, veterinarian at the North Idaho Animal Hospital and author of "The Healing Power of Pets." "It's not bad for the dog. People get freaked out because dogs are very much drawn to the smell of decaying flesh, but dogs are scavengers by nature," he adds.



Escalator injuries

Pearson, E., Whelan, M., Bracker, K., *Escalator-related injuries in 30 dogs (2007-2014)* *Veterinary Emergency and Critical Care Society*, 27(4), pp. 434-438, 2017.

Objective

A description of the types of injuries sustained by dogs in relation to escalator use, and the typical population of dog that appears to be at risk for these injuries.

Methods

This retrospective study pulled veterinary records for dogs that had sustained escalator related injuries, as reported by their owners at the time of receiving emergency veterinary care at a large emergency care centre in an urban area, during a seven year period.

The mechanism of injuries, body parts injured, and the severity of the injuries were examined.



Results

Take the stairs.

In 2007 in the United States approximately 90% of escalator related injuries in people occurred as a result of falls, with only 10% of the injuries resulting from entrapment of hands or feet. Adults, and specifically seniors over the age of 65 have been found to be more often injured in falls than in entrapment. However, children under the age of 19 (and at increased numbers under the age of 5) were more often injured by entrapment of hands or feet. In this analysis, 100% of the injuries sustained by the 30 dogs were a result of entrapment of one or more feet in the moving parts of the escalator, with a particular risk noted at the termination of the escalator. The injuries observed in dogs, therefore, seem to more closely resemble the escalator-related injuries sustained by young children than by adults.

The majority of accidents in this study occurred in transit stations, and 27 of the 30 dogs were small breeds. Of the three large breeds, 2 were working service animals. One small breed dog was also a service animal. While none of the injuries were fatal, a few required either full or partial amputation of one or more toes.

76% of the injured feet (39, between the 30 dogs) were hind feet, with only one dog sustaining injuries to all four feet. The third digit was the most injured (48%) followed by the second digit (38%).

Injuries were limited to the feet and included skin lacerations, torn toenails, partial degloving injuries, paw pad avulsions, and avulsed digits. Phalangeal fractures occurred in 5 patients of the 9 that received radiographs. 50% of the injured dogs were treated surgically and amputations (partial or whole) were performed on 8 of these dogs. The other 15 dogs were treated conservatively, and of those surgery was recommended and declined for 7.

The small sample size makes it difficult to tell if small dogs are more prone to entrapment in an escalator, perhaps due to their smaller foot size; or if small dogs are more likely to be found on escalators, or if the local demographic of the study area itself just happens to be biased towards small dogs. It is noted that the data was collected from an urban area, where small dogs may be more common. It is interesting, however, that the only dogs in the study reported to be medium or large dogs were the service dogs (guide dogs for the blind).

It is also notable that guide dog training facilities often recommend the use of protective footwear on the hind feet of working service animals, as they find, as this study did as well, that the hind feet tend to be more prone to injury than the front.

Thoughts: Take the stairs indeed! And how interesting about the recommendation for service dogs to wear protective footwear on the hind feet. I just included this study because it was so unique!



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