

Extensive AMR infection in tail with abscess and coccidiosis

Bearded Collie Male 11 years old

“Day 0” equals first day of MPPT treatment

An 11-year-old active, male Bearded Collie developed what seemed to be a cyst on his tail. As it started to bleed and discharge it became clear that it was an abscess. The vet squeezed out the contents leaving a hole where the abscess had been and the owner was instructed to keep the area clean with antiseptic soap (Chlorhexidine) and a commercially available antiseptic spray. The infection, however, spread to involve a much bigger area and was excruciatingly painful and exuding profusely from the wound where the abscess had been as well as through the surrounding infected skin. The vet recommended the tail be amputated. (Pic 1, 2). However, the likelihood of this approach having a successful outcome was unclear as the swelling and inflammation indicated that the internal infection apparently had already reached well beyond the most proximal possible location for amputation (pic 1, 3, 4, 5, 6). This would mean that infection was already affecting the dog's trunk. The dog was injected with 3 different types of antibiotics for the courses to be finished via oral administration. 400mg Amoxicillin+100mg Clavulanic acid (Clavaseptil) twice daily; 750mg Metronidazole (Metrobactin) twice daily; and 10mg Marbofloxacin (Marbocyl) once daily. In addition, twice daily the tail was applied a topical antibiotic gel consisting of fusidic acid combined with the corticosteroid, betamethasone (Isaderm). He was also placed on two types of analgesics, Meloxicam (NSAID) once daily (Loxicom), and paracetamol (acetaminophen) thrice daily, both standard doses for a 24 kg dog. The antibiotics changed the nature of the infection to a drier, more virulent and rapidly spreading agent (pic 3, 4, 5, 6, 7, 8).

Two days later, an approximately 18-19 cm long infection spanned the dorsal and both laterals of the tail exposing a large area of dry, black eschar mixed with softer, thick eschar (pic 7). Infection was actively infiltrating and breaking down the skin and soft tissue proximally, distally as well as right laterally from the focus of the abscess-wound area located dorsally mid-tail, which seemed to dominate the clinical picture (pic 7, 8). The same was the case for the left lateral but the black, dry nature of the breakdown against the dark grey skin colour, made its appearance less obvious. Whilst the dry hard eschar prevented localised swelling, swelling was prominent in the entirety of the tail proximal to any eschar (pic 5, 6, 7) and the inflammation reached beyond the base of the tail into the entire anal region bordered by the areas overlying both ischial arches and tuberosities (pic 11). Ventrally, the tail was affected in its entirety between this anal region and well beyond the location of the distal border of the abscess-wound (pic 11). Distally to the abscess wound area, the tail was scaly indicating that the infection was spreading and that a breakdown of the skin was eminent (pic 12). MPPT treatment was now commenced. (pic 9, 10, 11, 12). All medication was stopped, except the acetaminophen which was continued for one or two days.

The advance of the infection was promptly halted. Autolytic debridement, which was the first requirement in the restoration of the tissue lost to the widespread infection, alongside granulation were recognisable within 24 hours. The immune system makes the distinction between viable and non-viable structures and disposes of anything non-viable via autolytic debridement as such necrotic material constitutes a nutrition rich breeding ground for many infective agents. Concomitantly, the immune system supports tissue regeneration, which is particularly recognisable as the granulation and epithelialisation processes throughout until full closure.

MPPT cannot work through completely hard and dry eschar. Accordingly, it worked along the edges and through any openings in the eschar, isolating and rejecting it (pic 13, 14, 17) together with other necrotic tissue and infective debris (pic 15, 16, 17). Within a few days, this cleaning up procedure exposed the broad extent of the infective infiltration and breakdown (pic 18, 19, 20, 21, 22, 26). This further supported the clearing of the deeper structures and the affected areas under the skin progressively further away from the wound openings.

Simultaneously with the autolytic debridement, the lost tissue started regenerating and became visible in the form of granulation in the wound bed and in the wound edges (pic 19, 20, 22, 23). Also, the advancing infection in the distal part of the tail had cleared within a few days and the skin had recovered (pic 24).

After a week, no more eschar was present and the opening of the main wound was approximately 11 cm wide circling the tail three-quarters from ventral (6 o'clock), over left lateral, and dorsal, to right lateral (3 o'clock) (pic 20, 22, 27) with a depth varying between 10 and 15mm. Healing was already well underway. The pronounced swelling of the entire proximal part of the tail between the main wound and the base of the tail and in the anal region (pic 5, 6, 9, 10, 11, 14, 16) had now become more accessible, and the deeply settled infection that was hidden under the protection of the skin was being fought using all wound openings to dispose of the debris created in the process, e.g. gas and dead cells (pic 19, 21, 22,). The left lateral was the worst affected part (pic 19, 21, 22, 26, 28, 29, 30). The pronounced swelling of the anal region (pic 15, 16, 18, 25, 26, 29, 30) would follow a pattern similar to the tail itself. All skin lesions would be debrided and healed, the diffuse swelling would reduce into distinct, controlled pouches above the anus, along both sides of the anus, and in the adjacent, proximal, left side of the tail (pic 31, 32). The anus itself would remain slightly inflamed (pic 31, 32).

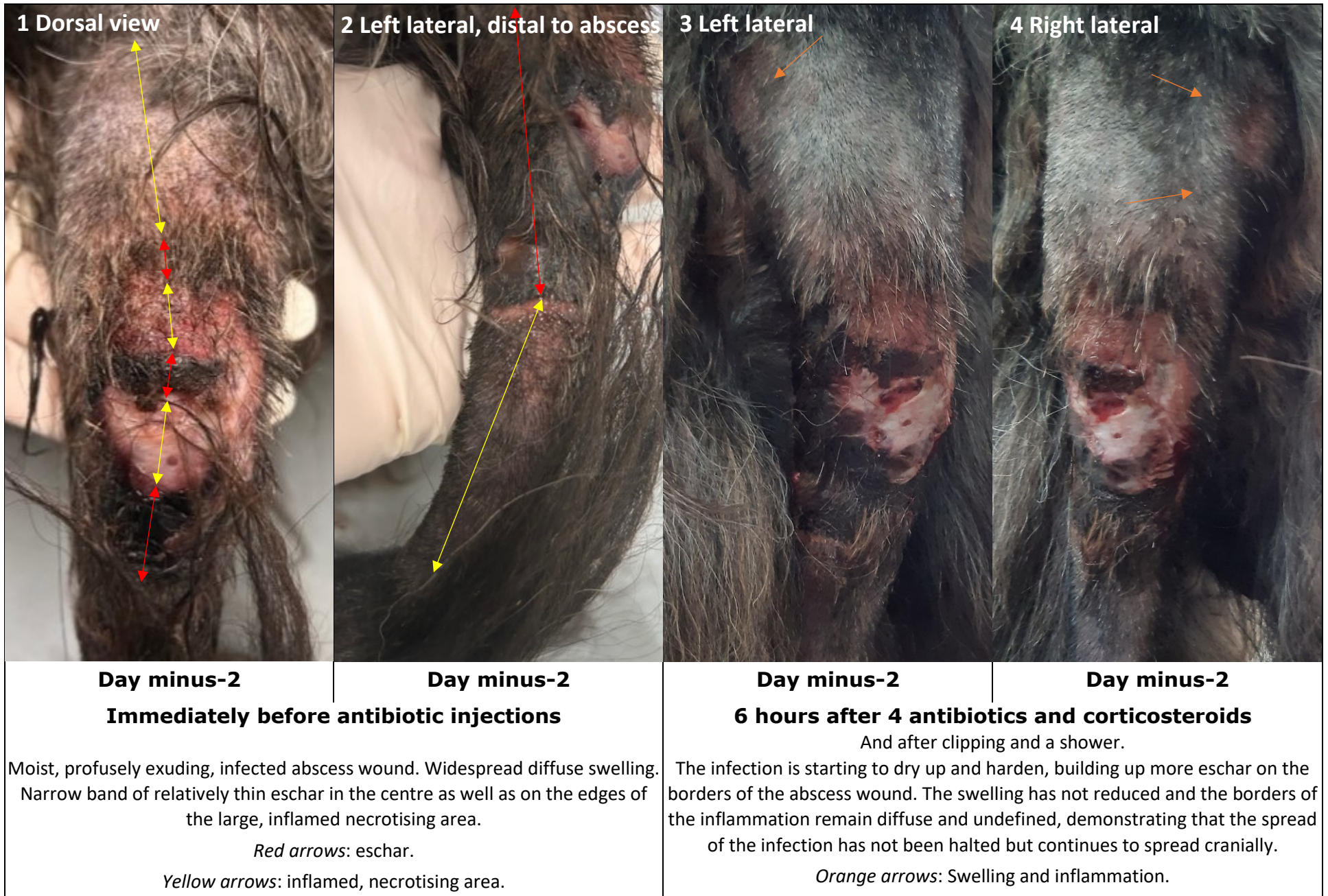
After 10 days, the wound bed had built up substantial new tissue and was granulating in all areas. All wound edges were healthily epithelializing, with the distal and right lateral edges already having reduced the size of the opening considerably (pic 34, 35, 36). The tail had regained its straight, symmetrical shape (pic 33) and the general swelling had reduced considerably. The proximal left lateral of the tail at its base still held some swelling and the anal region continued to display the swollen pouches (pic 33 & 31,32). The wound progressed rapidly towards closure ~~from the distal and right lateral~~ with pigmentation and new hair follicles moving in fast. (pic 37, 38, 39, 40, 41, 42, 43, 44, 45). The ventral and left lateral areas of the tail were the most severely affected by deep-seated infection. Like the rest of the tail, the healing of these areas, progressed in a caudal-to-cranial direction. No area was left without protective epithelium but the removal of the infection continued through minute, temporary areas, opening and closing as required in order to dispose of infective debris (pic 46, 47, 48, 49). A few of such "vents" remained along the left lateral spanning from the main abscess wound to the anal region and the anus itself until the concealed infection had been cleared from the tail allowing full completion of healing (pic 50, 51,54, 55) picture of ventral).

The diffuse swelling in the anal region continued to reduce, concentrating into more prominent pouch-like structures in the area immediately surrounding the anus (pic 48, 49, 52). Finally, on Day 54, the anus revealed the contents of the swollen pouch-like structures, by releasing a collection of pus during washing (pic 53). The elimination of this concentrated infective matter led to a marked improvement in the anal region over the following days. The remaining adjacent "vent" structures ventrally on the tail closed and pigment and hair started to move in (pic 55). The evacuation of the pus confirmed a clear association with the anal sphincter, which remained affected (pic 55), revealing that the root cause of the continued unsettled status in the anal region likely should be searched for inside the rectum.

The dog had the previous year suffered a coccidiosis infection which had been treated with antibiotics but not retested for complete resolution following treatment. Despite the whole tail and anal region appearing healthy and free from infection, twice weekly MPPT treatment was required to maintain this infection free status. It was now decided (pic 56) to investigate whether this parasitic infection may not have been fully resolved but instead turned latent and

chronic. A low coccidiosis (*Cystoisospora*) infection was confirmed (pic 57, 58) and, over the following month, the twice weekly MPPT treatments were supplemented with immune supporting dietary supplements and probiotics. The tail continued to improve and one month later, when the follow-up coccidiosis test came back negative on Day 107, all epithelium was seamless and fully pigmented with regrowth of hair in practically all areas except the centremost part of the original abscess area. (pic 59, 60).

The tail and wounds continued to improve displaying strong remodelling and maturation. At a follow-up 6 months from start of MPPT (pic 61, 62) the initially 10-15 mm depth of lost tissue in the original abscess area had been regenerated to the extent that it only displayed a very slight concave curvature if deliberately searched for. The hair follicles on the entire tail seemed to have regenerated except on a limited area of this original abscess area. Flakes on the surface of this area revealed that regeneration processes were still ongoing underneath the protection of the skin. Regeneration normally continues for many months or even years, and it will be interesting to see whether this tissue may still fully normalise. The dog had regained his usual lively and energetic nature. The function of the tail had not been affected and the dog displayed no signs of discomfort in the tail or anal region.





Day minus-1

Day minus-1

Day 0

Overview, whole tail

Day 0

Closeup, abscess

24 hours with 4 antibiotics and corticosteroids

The tail is dryer and covered with more eschar, under which the infective agents can thrive. The infective debris has changed to a higher viscosity, retaining a higher proportion of the debris in the soft tissue, where it can cause further necrosis. Cracks in the eschar display inflammation underneath it.

Both sides of the base of the tail are swollen and inflamed.

The tail is clearly twisted and asymmetrical.

Orange arrows: Swelling and inflammation.

Light orange arrows: Swelling and inflammation in the anal region.

Red arrows: proximal and distal border of eschar, respectively.

48 hours with 4 antibiotics and corticosteroids. Pre-wash

Pronounced asymmetry at the base of the tail with a clear twist around mid-tail. The eschar has fortified further and the areas, which were allowing the debris to exit, are also drying out.

The tail is distinctly swollen at the base of the tail as well as proximally and distally to the abscess wound area in which the hard eschar prevents the change of shape.

Blue circle: A single dryish drop of infective debris is forcing its way out.



Day 0

Day 0

Day 0

Day 0

Post-wash. Before first MPPT

6 hours after MPPT application

The showering immediately before MPPT application has further unveiled the extent of the inflammation.

Earliest pictures available of the anal region, the ventral side of the tail, and the part of the tail distal to the abscess.

Orange arrows: Swelling and inflammation.

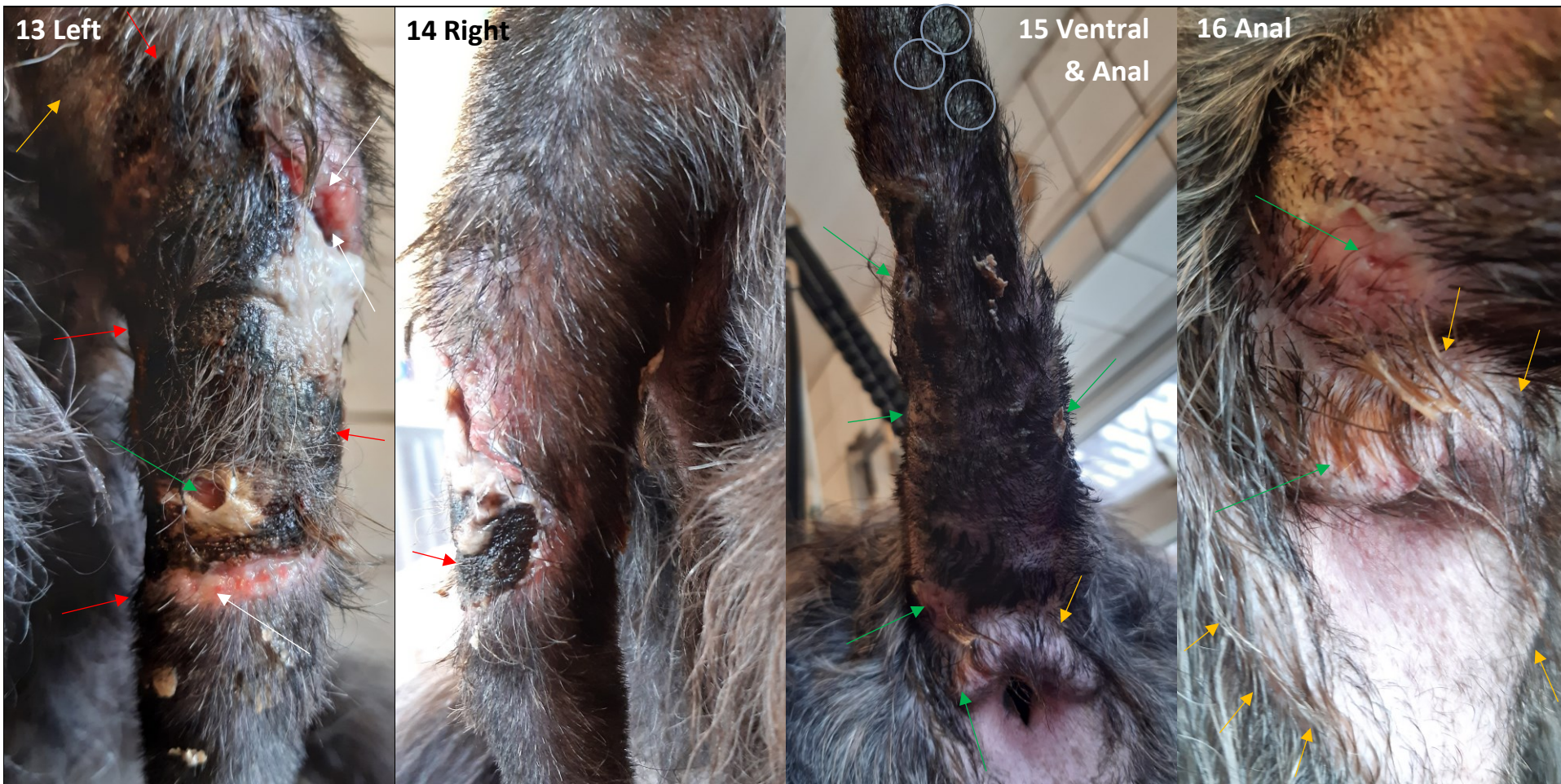
Light blue arrows: skin breaks

Light orange arrows: Swelling and inflammation in the anal region.

The anal region is inflamed with wound openings scattered across the ventral side of the tail.

The scales indicate that the infection is spreading underneath the skin and are a precursor of skin break-down.

Red arrows: reach of the eschar.



Day 1

Day 1

Day 1

Day 1 - closeup

Autolytic debridement is working through all openings in the skin and is creating and exploiting borders and holes in the eschar to penetrate and debride underneath it. This clean up enables the viable tissue to granulate.

Pronounced swelling proximal to the eschar.

White arrows: Granulation *Red arrows:* Eschar

Green arrows: Openings through which MPPT has access and the debris, resulting from the debridement, is expelled.

Light orange arrows: Swelling and inflammation in the anal region.

Grey circles: Grey thickened areas with skin breakdowns undergoing epithelial repair.



17 Dorsal

**Day 2 - closeup
Pre-wash**

Loosening of the eschar along its borders. Expulsion of infective debris through the border canals.

18 Dorsal

**Day 2
Post-wash**

The loosened eschar came off in the shower exposing viable wound bed and edges underneath.

The edges show budding granulation. The eschar on the tail's left side has separated from the viable wound bed and is waiting for the autolytic debridement processes to finally separate it from the skin on the tail's ventral side.

The proximal part of the tail remains swollen and holds infection under the skin.

19 Dorsal-left

**Day 2 - closeup
Post-wash**

Viable wound bed and edges.

20 Right

**Day 2 - closeup
Post-wash**

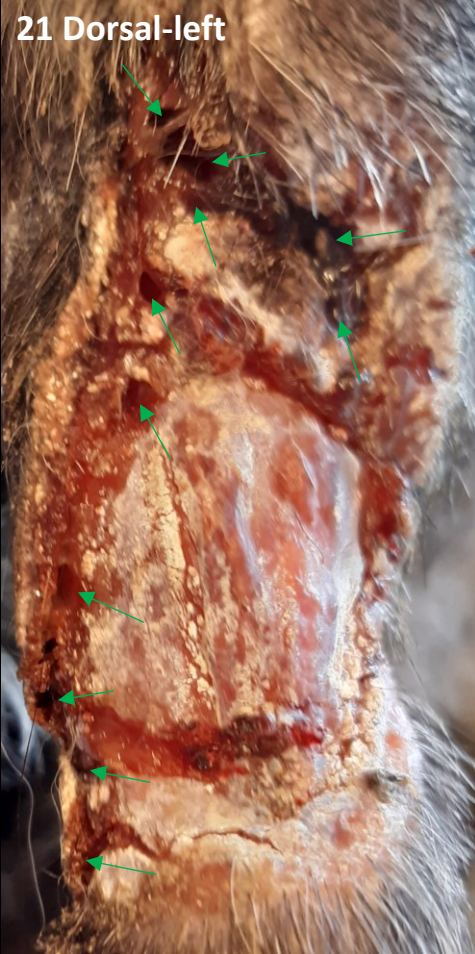
The right edge is clean, granulating, i.e. regenerating lost tissue, with epithelialisation underway.

White arrows: Granulation *Red arrows:* Eschar

Green arrows: Separation between viable tissue and eschar through which the debris from the infection under the eschar and in the proximal tail is expelled.

Orange arrows: Swelling and inflammation.

Light orange arrows: Swelling and inflammation in the anal region.



21 Dorsal-left

**Day 3 - closeup
Pre- wash**

The infection is clearly buried under the proximal skin, with particularly strong signs of ongoing autolytic debridement in the proximal and left sides.

Green arrows: openings through which gas, toxin and other debris from the infection, including in the proximal tail, are expelled.

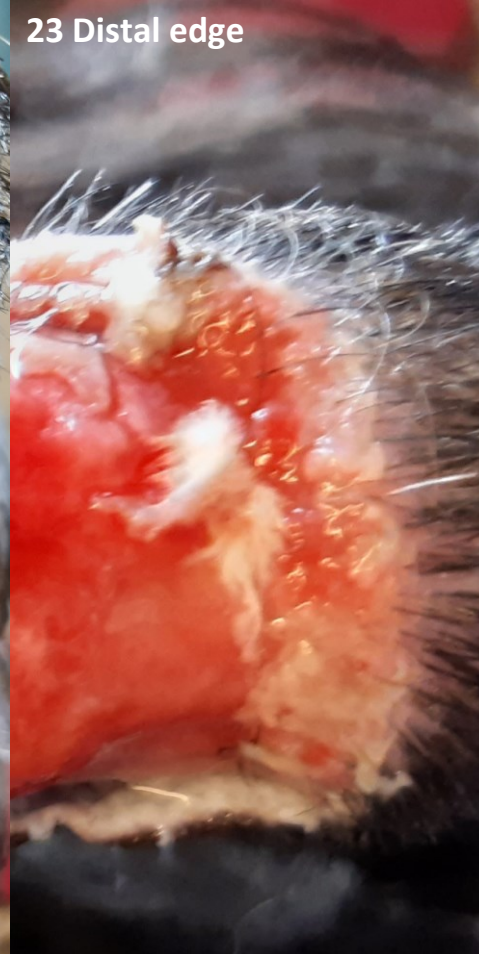
Red arrows: Eschar.



22 Dorsal-left

**Day 3 - closeup
Post- wash**

Further necrotic tissue has been cleaned out proximally and along the left border. Proximal, distal and right lateral wound edges are granulating and the wound bed is actively regenerating, building up new tissue from the bottom.



23 Distal edge

Day 3 - snippet

Healthy, budding, pink granulation. Healthy epithelisation, detectable as a white-grey skin edge with no distinct border.



24 Distal to abscess wound

Day 3

Distal from the open wound

All scales have disappeared (pls. compare to pic 12) and the skin is healthy, indicating that the spread of the infection has been halted and is retreating.



25 Anal & Proximal ventral

Day 4

Swelling of the anal region. Inflammation in the entire region between the open wound and the anal region, particularly along the left lateral.



26 Left lateral, left anal

Day 4

Inflammation in the entire left side between the anal region and just beyond the open wound revealing the deep-seated infection; and negligible skin breaks providing exit opportunities for the trapped infective debris. Only a narrow border of black eschar remains of the entire left lateral edge.



27 Ventral

Day 7

All eschar and necrosis have gone from the left side of the wound reaching into the ventral side of the tail. Wound edges can now recover. Proximally, between the open wound and the base of the tail, inflammation and swelling is still obvious.



28 Proximal left lateral & Left anal

Day 7

Inflammation has reduced. Openings are allowing the drainage of infective debris thereby reducing the swelling. Wound remains open and keeps receiving the bulk of the infective debris that needs to be expelled from the proximal part of the tail. This debris is then washed off daily.

Green arrows: Openings through which MPPT has access and the debris, resulting from the debridement, is expelled.

Dark orange arrow: Swelling and inflammation in the tail.

Light orange arrows: Swelling and inflammation in the anal region.



Day 8

Epithelialisation is progressing on all wound edges, in many places under the protection of brown film. The proximal left wound corner is discarding non-viable and repairing viable epithelium. The infective debris, from the swollen infected proximal tail tissue, is expelled, including through these grooves.

The wound bed is granulating.

The anal region is swollen from the infection infiltrating under the intact skin.

Green arrow: Grooves and skin openings in the recovering skin tough which the debris from the infection is expelled and through which MPPT has access.

Dark and light orange arrows: Swelling and inflammation in the tail continues to be bounded and move proximally, concentrating into pouches in the anal area.

Day 10

The diffuse swelling and inflammation is gradually concentrating in pouch-like structures.

The skin openings are closing.

Negligible inflammation is detectable at the anal sphincter.

Blue circles: Inflammation.



Day 10

Day 10 - closeup

Day 10 - closeup

Day 10 - closeup

The tail has regained its symmetry and is no longer wonky. Some swelling remains at the base of the tail on the left side (*dark orange box*).

All wound edges are displaying greyish-white, tensile epithelialisation.

The whole wound bed is granulating.

Dark and light orange arrows: Swelling and inflammation in the tail continues to be bounded and move proximally, concentrating into pouches in the anal area.



Day 20 - closeup
All wound edges continue epithelializing.
The wound has reduced enough in size for all edges to be visible from a single angle, i.e. dorsal-left.
Dark orange arrow: The infection under the skin is still detectable in the proximal part of the tail despite the wound closing rapidly.
Green circle: Ongoing epithelial repair of "vent" in otherwise intact skin.



Day 20
The skin is practically restored in the ventral proximal tail. Temporary openings, "vents", in the otherwise intact skin allow the debris from the deeper infection to pass through.



Day 26
Overall, the infection is well controlled and the tail is healing well.



Day 32 - closeup



Day 33

Right side is fully closed. The new epithelium has been fully pigmented and practically all hair has returned

The anal region still exposes a pronounced, swollen pouch.

Light orange arrows: Swelling and inflammation concentrating in pouch in the anal region.

Day 33

Healthy epithelium fully restored along entire ventral tail.

Swelling considerably reduced.

Day 35 - closeup

Rapid pigmentation of the new skin. New hair follicles are moving in fast.

Day 39 - closeup

45 Dorsal



Day 41 - closeup

46 Dorsal



Day 48 - closeup

47 Left lateral & Anal



Day 48

48 Anal region from left



Day 49 - closeup

The wound is fully epithelialized. Tiny, uneven, temporary openings are still visible in the skin. They serve as “vents” that allow the debris from the deeper infection to pass through the skin to the surface.

Pronounced, swollen pouch above anus and protruding, generalised swelling of the rest of the anal region. The swelling is now limited to the anal region and no longer diffuse.

Green circles: Ongoing epithelial repair of “vents” in otherwise intact skin.

Light orange arrows: Swelling and inflammation gradually concentrating in pouches in the anal region.



Day 49

Deformed anal region with strong “pouch”-like swelling and light inflammation above and along both sides of the anus, and involving the entire sphincter.

Slightly damaged skin “vents” along the ventral proximal part of the tail.



Day 51 - closeup

The main wound is fully closed. No vent remains, demonstrating that the infection in the tail is gone. Pigmentation is restored except for approximately 6-8 square mm still missing. Hair follicles continue to move in.

Green circles: Ongoing epithelial repair of “vents” in otherwise intact skin.

Light orange arrows: Swelling and inflammation in pouch around anus.

Blue circle: inflammation



Day 53 - closeup



Day 53

Changed but still deformed anal region with pouch-like swelling above and along both sides of the anus involving the sphincter, in particular the upper right quarter.

“Vent” on the ventral proximal part of the tail.



Day 54

Squeezed gently but firmly, pus came out of the anus indicating a rectal infection.

Suspicion of chronic coccidiosis.

Day 55 - closeup

The skin continues to mature. Pigment continues to move in. New hair follicles continue to appear.

Day 58

The rectal sphincter itself is inflamed and the anal region directly adjacent to this part of the sphincter is swollen. The "vents" along the ventral proximal part of the tail have closed and disappeared. Hair is moving into the area.

Day 76 - closeup

Coccidiosis tested

Tail is completely healed and there is no sign of infection or other trouble. Pigmentation is fully restored and new hair follicles and hair continue to move in with.

Blue circles: inflammation



57 Anal

Day 84

Coccidiosis test positive, low

Swelling practically gone from the anal area. No pouch formation. Anus symmetrically, well-shaped but slightly, subtly inflamed.



58 Left

Day 84 - closeup

Maturation of the healthy-looking skin continues. The original wound is becoming harder to identify when searching the tail.



59 Anal

Day 109

Coccidiosis test negative

Anal area displays full symmetry. No swelling. No inflammation.



60 Left

Day 109 - closeup

Wet fur on the original abscess area allows identification of the area that was formerly affected.

Blue circle: subtle inflammation

61 Anal & Proximal ventral



62 Dorsal-left



Day 183 - overview

6 months follow-up

Anal area displays full symmetry. No swelling.

All hair is restored in the anal region and ventral side of the tail.

Dog is behaviourally back to his old self.

The function of the tail is unaffected with no signs of discomfort in the region.

Day 183 - overview

All hair is firmly tucked under the tail to facilitate photography.

New tissue has filled in the cavity of the deep abscess wound. The new skin is healthy with full pigmentation, and hair follicles continue to move in – particularly visible in the proximal part.

The rest of the tail has fully restored pigmentation and hair growth.