



### SKIN DEEP

Treatment of pyoderma is driven by whether it is classified as surface, superficial, or deep.



## DERMATOLOGY

# Pyoderma in the Dog

**Jennie Tait, AHT, RVT, VTS (Dermatology)**  
Veterinary Allergy Dermatology Ear Referral (V.A.D.E.R.) Clinic  
Morriston, Ontario, Canada

**P**oderma literally translates to “pus in the skin” and is the term used for bacterial infections, even when no pus is seen. The most common form of pyoderma in dogs is superficial bacterial folliculitis, which is also the primary reason for systemic antimicrobial use in small animal practice.<sup>1,2</sup> Although most staphylococcal bacteria are part of the normal flora of a dog’s skin, several more aggressive (coagulase-positive) staphylococci are frequently associated with cutaneous disease. Most cases of superficial bacterial folliculitis are caused by *Staphylococcus pseudintermedius*,<sup>3</sup> followed less frequently by *Staphylococcus aureus* and *Staphylococcus schleiferi*.<sup>4,5</sup>

## TYPES OF PYODERMA

Pyoderma can be classified as 1 of 3 types: surface, superficial, and deep (**FIGURE 1**). Classification is important because it drives treatment choices. Each type of pyoderma can be primary or secondary. Patients with primary pyoderma have otherwise healthy skin, and specific antibacterial therapy is curative. Patients with secondary pyoderma have compromised skin, and treatment must also deal with the underlying, predisposing condition(s).

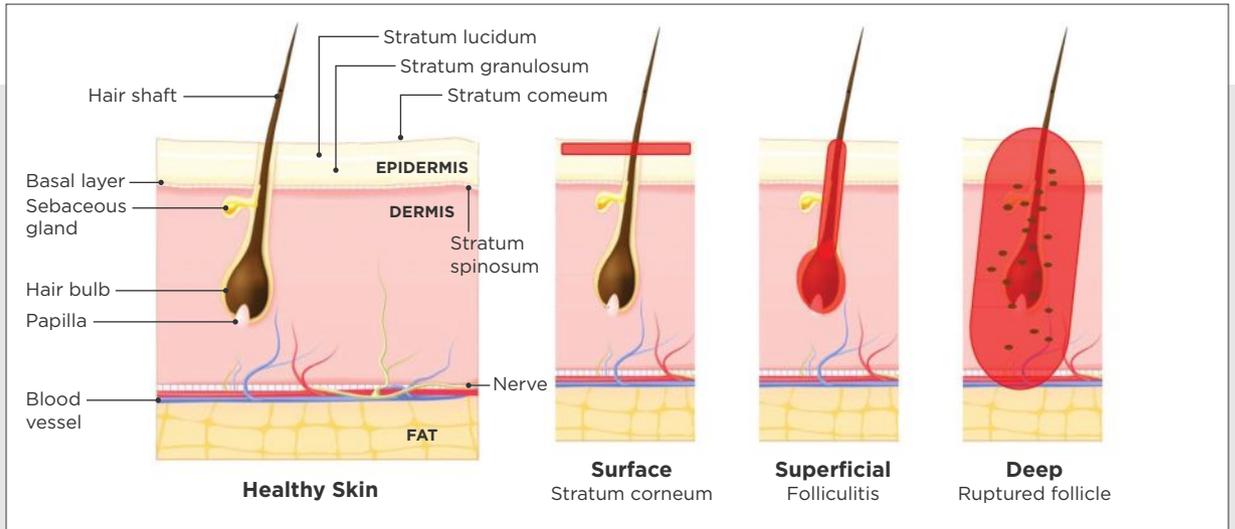
### Surface

As the name suggests, surface pyoderma affects only the epidermis, specifically the layers between follicles. Surface pyoderma includes acute moist dermatitis (hot spots), skin-fold pyoderma (intertrigo), and microbial overgrowth.

Acute moist dermatitis is largely self-inflicted as a result of an underlying pruritic problem (e.g., flea

allergy, anal sac irritation, otitis, foreign body, arthritis). Clipping will often reveal a larger affected area with lesions ranging from erythematous papules to erosions and ulcers. Acute moist dermatitis is not considered a “real infection” unless self trauma has caused a deeper infection.

Skin-fold pyoderma results from disruption of the outermost stratum corneum, caused by friction of skin against skin (**FIGURE 2**). Irritation causes inflammation, which leads to increased heat and moisture, thereby providing the ideal environment for overgrowth of bacteria and/or yeast. Cytology will typically yield elevated numbers of staphylococci and/or yeast with few or no inflammatory cells. Microorganisms in the absence of inflammatory cells can indicate overgrowth of natural flora or an immune deficiency resulting in lack of an inflammatory response to infection.



**FIGURE 1.** Illustrations of types of canine pyoderma.

### Superficial

Superficial pyoderma involves the epidermis and/or hair follicles. Types of superficial pyoderma include impetigo (puppy pyoderma), folliculitis, superficial spreading pyoderma, and mucocutaneous pyoderma.

Impetigo is seen in prepubescent dogs. Nonfollicular pustules are often found in the axillae and inguinal region, and pruritus is uncommon. Impetigo is rare in adults and is usually secondary to an underlying condition (e.g., hyperadrenocorticism, diabetes mellitus, hypothyroidism).<sup>6</sup>

Folliculitis is common in dogs and is often secondary to underlying allergies (**FIGURE 3**). Folliculitis is also called “short-haired dog pyoderma” and produces a moth-eaten appearance of the coat (**FIGURE 4**). Folliculitis can be concurrent with superficial spreading

pyoderma, appearing as papules, pustules, and epidermal collarettes. Plugged follicles (increased keratosis of hair follicles), also called comedones, can also lead to infection and are often seen secondary to long-term use of corticosteroids as well as with other conditions that compromise hair follicles (**FIGURE 5**).

Mucocutaneous pyoderma often affects the lips but can also affect other mucocutaneous junctions (**FIGURES 6 AND 7**). Lesions include erythema, crusts, erosions, and ulcers. Should lesions be refractory to systemic antibiotics, biopsy samples should be collected to look for immune-mediated skin disease.

### Deep

Deep pyoderma is an infection that has penetrated down into the dermis and is accompanied by localized



**FIGURE 2.** Interdigital erythema/pododermatitis.



**FIGURE 3.** Pyoderma in an atopic dog.

folliculitis and furunculosis, generalized deep folliculitis and furunculosis/cellulitis, bacterial pseudomycetoma (i.e., botryomycosis), and acral lick dermatitis. Furunculosis involves ruptured hair follicles that allow bacteria and keratin into surrounding tissues. Keratinous debris will cause a foreign body reaction, resulting in furuncles (boils) and then draining tracts. Exudate from deep pyoderma can contain small granules with microorganisms that are diagnostic for botryomycosis.

### Localized Deep Pyoderma

Deep pyoderma can be localized, often to the chin, muzzle, paws, and/or pressure points. Folliculitis and furunculosis on the chin and muzzle are most common in adolescent dogs and are usually transient but sometimes persist, especially in Doberman pinschers, boxers, bulldogs, Great Danes, mastiffs, Weimaraners,

and German shorthaired pointers.<sup>6</sup> Deep pyoderma can also progress to cellulitis.

Callus or pressure point pyoderma affects contact areas such as elbows, hocks, stifles, and digits, most commonly in large breed dogs (**FIGURES 8 AND 9**). Crusting or matting of hairs can mask ulceration and draining tracts. Underlying conditions that can contribute include inadequate bedding, poor circulation, and endocrine disease.



**FIGURE 4.** Moth-eaten appearance of coat.



**FIGURE 5.** Epidermal collarettes (**white arrows**). Hyperpigmentation at the center with a torn circular edge gives the look of a “target lesion.” Note the cutaneous atrophy and comedones (**black arrows**) resulting from chronic corticosteroid administration to manage allergic symptoms.



**FIGURE 6.** Periocular mucocutaneous pyoderma.



**FIGURE 7.** Mucocutaneous pyoderma of lip fold.



**FIGURE 8.** Deep pyoderma of elbow callus.



Acral lick dermatitis is the result of tissue maceration from continual licking, often on the cranial aspect of a distal limb (**FIGURE 10**). The erythematous plaque that forms is continually impregnated with oral microorganisms and progresses to a granuloma. Causes can be organic (e.g., ruptured hair follicles or foreign body reaction) or psychogenic. Always search for an underlying cause, including arthritis, before concluding that the problem is psychogenic.

Interdigital pyoderma can also lead to folliculitis and furunculosis (**FIGURE 11**). Feet may be swollen with purulent discharge, along with paronychia, causing an abnormal gait, which can cause other hairs to be driven into the skin, fostering even more foreign body reactions. Underlying factors that can lead to severe pododermatitis and interdigital pyoderma include demodicosis, trauma from gait abnormalities, allergies (including contact reactions), dermatophytosis, autoimmune diseases, endocrinopathy, immunodeficiencies, zinc-responsive dermatosis, and superficial necrolytic dermatitis (hepatocutaneous

syndrome, necrolytic migratory erythema, metabolic epidermal necrosis).<sup>6</sup>

### Generalized Deep Pyoderma

Generalized deep pyoderma causes furunculosis, nodules, and draining tracts that can affect much of the body. Patients may initially respond to treatment but later experience recurrence. There may be some genetic predisposition to deep pyoderma since German shepherds are overrepresented.<sup>6</sup> However, in the author's experience, this predisposition was more frequent years ago than it is today, perhaps reflecting a benefit of selective breeding. Other possible underlying



**FIGURE 9.** Deep pyoderma at a pressure point over the hip of a German shepherd.



**FIGURE 10.** Deep pyoderma of lick granuloma.



**FIGURE 11.** Keratin causing a foreign body reaction, resulting in interdigital cysts.

Courtesy Anthony Yu, V.A.D.E.R. Clinic (5). Opposite: Courtesy Anthony Yu, V.A.D.E.R. Clinic (2)

**TABLE 1 Diagnostic Cytology for Pyoderma<sup>6</sup>**

TYPE OF PYODERMA	CHARACTERISTIC LESIONS	IDEAL SAMPLE SITE	DIAGNOSTIC TECHNIQUE
Surface	Erythema, papules, and erosions	Exudative erosions	Impression smear
Superficial	Papules, pustules, crusts, epidermal collarettes, hyperpigmentation	Intact pustule or area under crust	Impression smear of lanced pustule, tape prep (for epidermal collarettes or papules), or direct smear
Deep	Papules, nodules, crusts, furuncles, and/or draining tracts	Fresh exudate, squeezed from a lesion	Direct smear or impression smear

conditions include allergies, endocrinopathies, demodicosis, ehrlichiosis, and immunodeficiencies.

## DIAGNOSIS

The diagnostic approach to pyoderma includes taking a thorough history, examining the skin for lesions and distribution patterns, and performing diagnostic testing consisting at a minimum of cytology.

For patients with recurrent canine pyoderma, always look for the underlying cause(s). Factors that predispose a dog to pyoderma are numerous; therefore, unless the underlying cause is addressed, secondary pyodermas will continue to occur.<sup>6,7</sup> Predisposing factors to recurrence include the following:

- Inadequate nutritional management (diet balance and caloric intake), body score, husbandry, housing, lifestyle/activity level, and environment
- Physical factors such as trauma, maceration, and foreign bodies
- Ectoparasite (e.g., fleas, mites, lice) and intestinal parasite (e.g., helminths) infestations
- Concurrent conditions (e.g., dermatophytosis; yeast infection; *Ehrlichia* or *Leishmania* infection; endocrine diseases such as hypothyroidism, hyperadrenocorticism, sex hormone imbalance)
- Altered immunity from drugs (e.g., glucocorticoids, cyclosporine), impaired skin barrier function, immunodeficiency syndromes, and hypersensitivities (e.g., food, environment, insects)

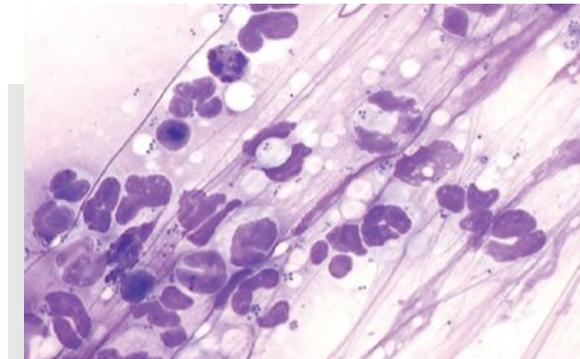
## Cytology

In-house cytology is an invaluable tool for treatment selection (**TABLE 1**). In fact, given the ever-increasing need for antimicrobial stewardship, it is a must. Easily performed in the clinic, cytology is a high-yield, low-cost procedure that enables timely and accurate diagnoses.

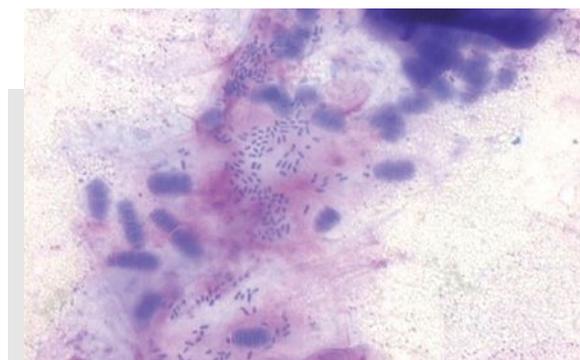
Cytologic examination identifies microorganisms (e.g., cocci, rods, *Conchiformibius* [previously known as

*Simonsiella*], yeast, fungal spores) and cells (generally benign inflammatory cells and/or acantholytic keratinocytes). Microorganisms are often intracellular and extracellular. Acantholytic keratinocytes indicate deep pyoderma or immune-mediated disease (the latter is a sterile condition but can lead to secondary infections).

When inflammatory cells are seen, the types of cells should be noted (**FIGURES 12 AND 13**). Neutrophils are produced in rapid response to infection, whereas



**FIGURE 12.** Direct smear stained with Diff-Quik showing inflammatory cells and intracellular and extracellular cocci at 100× magnification.



**FIGURE 13.** Acetate tape cytology slide stained with Diff-Quik showing extracellular rods and *Conchiformibius*, indicating contamination from saliva, at 100× magnification. Note the absence of inflammatory cells.



Neutrophils are produced in rapid response to infection, whereas macrophages are produced later and indicate more chronic conditions.



macrophages are produced later and indicate more chronic conditions. Eosinophils are often increased in dogs with autoimmune skin disease (e.g., pemphigus foliaceus), ectoparasites, and allergic responses.

Of the several ways to collect and process samples for cytology, the author's preferences include impression smears, tape preparations, and direct smears.

### Impression Smears

The author's diagnostic choice for any exudative lesion is an impression smear. She has found that uncomfortable patients are better able to tolerate collection of an impression smear rather than collection of a direct smear with an applicator.

Gently press a microscope slide to the exudate, allow it to air dry, and then stain it with Diff-Quik.

For superficial pyoderma, if you can locate a pustule, lance the pustule with a sterile needle and either create an impression smear with the exudate or collect the contents with a cotton-tipped applicator and gently roll it onto a microscope slide. If you find only 1 intact pustule and immune-mediated skin disease is suspected, save the pustule for biopsy and collect cytology samples elsewhere. If there are no intact pustules, lift a crust to collect cytology samples.

### Tape Preparations

If the author finds only epidermal collarettes or papules, then she will perform a tape preparation (FIGURE 14).

Tape preparations are also great for tight spots (e.g., interdigital spaces) and dry lesions.

Using a piece of clear tape no longer than a microscope slide, handle it by only 1 end (the author refers to this end as "the sacrificial fingerprint end"). With this end stuck to your fingertip, use your thumb to press the free end to the lesion (collarette or papule) several times, then securely attach the sacrificial fingerprint end to the edge of the slide furthest from the frosted end. Stain with Diff-Quik. Do not use the fixative for tape preps; instead, lower the free end of the tape down into the eosin stain and move it back and forth for a slow count of 10, then remove from the stain and allow any excess fluid to run back into the container. Next, lower the free end of the tape down into the purple stain and move back and forth for a slow count of 20. Some objects (e.g., yeast, mast cells) can take longer to stain, so extra time in the final stain is well spent. Remove from the stain and allow any excess to run off back into the container. Rinse both sides of the slide and tape with water until all runoff is clear. Remove the tape from the edge of the slide and place the sticky side down with the sacrificial fingerprint end nearest the frosted end of your slide (doing so helps with orientation and avoids assessment of your own fingerprint). Place the slide with tape between paper towels and press to remove any air bubbles and excess fluid. For a clearer image, apply 1 drop of immersion oil to the tape and place a 22-mm × 40-mm coverslip on top and then evaluate. The author's personal preference is to quickly assess the sample under the lowest power, looking for pockets of inflammatory cells, and then move up through objectives and apply another drop of immersion oil just before switching to the oil immersion lens.

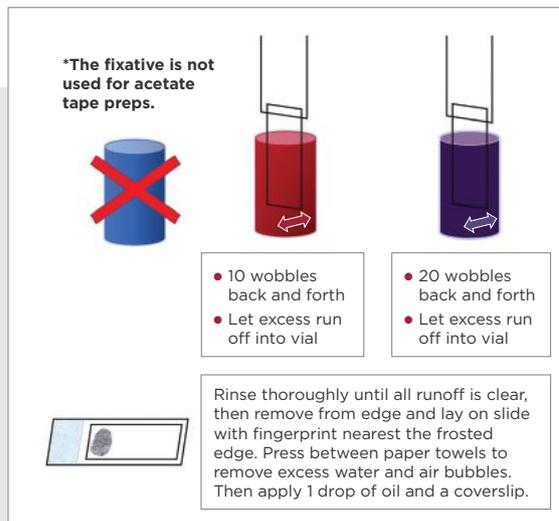


FIGURE 14. Processing acetate tape preps with Diff-Quik stain.



## Direct Smears

Direct smear samples can be collected by rubbing a cotton-tipped applicator on the lesion and then gently rolling the tip onto a microscope slide. This technique enables time-saving placement of multiple samples on 1 slide. For waxy or greasy samples, the author prefers to heat fix the sample and then wipe off any possible soot left behind with a Kimwipe (Kimberly-Clark, [kimberly-clark.com](http://kimberly-clark.com)) or similar tissue before fixing and staining with Diff-Quik. After staining, rinse both sides of the slide thoroughly with water until the runoff is clear. Use bibulous paper (blotting paper) to blot dry your slide, and then apply 1 drop of immersion oil and cover with a 22-mm × 40-mm coverslip. Use of a coverslip affords much clearer samples under the microscope, and this longer coverslip enables you to assess multiple samples on 1 slide.

For patients with deep pyoderma, squeeze the affected area and collect fresh exudate with either a cotton-tipped applicator or impression smear. This technique may require sedation.

## Culture

Occasionally, collecting a fine-needle aspirate or skin biopsy for culture and sensitivity is warranted in cases with deep pyoderma. Performing in-house cytology on the collected sample before submission will determine whether it is of diagnostic quality. In the author's opinion, ideal samples for culture are obtained from multiple sites on 1 swab, starting with the driest site (e.g., erythematous papules or an inflamed skin fold), then an epidermal collarette, and finally a moist lesion (e.g., a lifted crust). The gold standard sample is a pustule lanced with a sterile needle. The submission form should include your cytology findings and any suspicion of antimicrobial resistance.

## TREATMENT

### Topical

Topicals can kill microorganisms but also aid in restoring normal skin structure and function. In general, topical therapy is helpful for all patients with superficial bacterial folliculitis. Topical therapy alone (without concurrent systemic antimicrobial drugs) is encouraged as a desirable and recommended approach to the treatment of superficial bacterial folliculitis unless precluded by client and/or patient factors, especially in the following circumstances:

### Key points from The Guidelines for the Diagnosis and Antimicrobial Therapy of Canine Superficial Bacterial Folliculitis (Antimicrobial Guidelines Working Group of the International Society for Companion Animal Infectious Diseases)<sup>8</sup>

- Perform bacterial culture when response to empirical antimicrobial therapy is poor.
- Test to rule out differential diagnoses.
- Treat with topicals unless precluded by client and/or patient factors.
- Determine when and which first-, second-, or third-tier antimicrobial drugs are appropriate.

- Lesions are localized
- Generalized superficial bacterial folliculitis is in the early stages, when lesions are mild
- Diagnostic test results are pending

For generalized disease, topicals are available as shampoos, sprays, rinses, conditioners, and lotions. For localized infections, gels, creams, ointments, lotions, and wipes can be used.

### Systemic

Suitable antimicrobial drugs can be empirically selected if risk factors for drug resistance are not present. Should a culture not be necessary, antimicrobial drug therapy should be selected according to the recommendations outlined in Hillier et al.<sup>8</sup> These recommendations were developed by the Antimicrobial Guidelines Working Group of the International Society for Companion Animal Infectious Diseases, with consultation from diplomates of the American and European Colleges of Veterinary Dermatology in response to World Health Organization concern surrounding antimicrobial resistance. They include approaches to methicillin-resistant staphylococcal infections of small animals, diagnosis, therapeutic considerations, and preventive measures.<sup>8</sup>

Factors that increase the likelihood of antimicrobial drug resistance include the following:

- Within 2 weeks of appropriate systemic antimicrobial therapy, lesion reduction is less than 50%.



- New lesions (e.g., papules, pustules, collarettes) emerged 2 weeks or more after initiation of appropriate antimicrobial drug therapy.
- Residual superficial bacterial folliculitis lesions remain after 6 weeks of appropriate systemic therapy, and cytology reveals presence of cocci.
- Cytologic examination reveals intracellular rod-shaped bacteria.
- The patient or a pet in the same household has a history of multidrug-resistant infection.

Bacterial culture and sensitivity testing are never contraindicated. If culture and sensitivity are performed, selection of an appropriate antimicrobial drug should be based on the results.

## OUTCOMES

The prognosis for short-term outcomes of nonrecurrent pyoderma with appropriate treatment is good to excellent. Pyoderma can result from decreased immunity and is linked to compromised skin barrier function and underlying conditions that can be challenging to diagnose and resolve, which can result in recurrent superficial bacterial folliculitis, which in turn can lead to repeated courses of treatment. Unfortunately, repeated treatment with antimicrobial drugs often results in multidrug-resistant bacteria, a concern for animal and human health. The World Health Organization has declared antimicrobial resistance a global health and development threat that

requires urgent action. It is one of the top 10 global public health threats facing humanity, leading to an estimated 700 000 deaths per year.<sup>9</sup> As such, antimicrobial stewardship has become paramount and a new norm for the veterinary industry.

## CLIENT EDUCATION

All team members should be trained to communicate a consistent message to clients. When clients have a clear understanding of their dog's condition and how every part of their treatment protocol is expected to improve quality of life, their compliance improves, frustration for all is minimized, and patients get back their quality of life. Here are a few communication tips for clients whose dog has pyoderma.

- Staphylococcal bacteria are normal flora (typically found on a dog's skin without causing disease).
- Infection does not occur unless something is wrong with the skin barrier and/or the immune system.
- Administering and applying medications as directed is the route to success.
- Most dogs with recurrent pyoderma will require lifelong management and may occasionally experience flare-ups.
- Outcomes will depend on the patient's current condition, underlying condition, and compliance with treatment. **TVN**

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### Jennie Tait

Jennie graduated as an animal health technician in 1986. She worked in general practice for 3 years, at the Ontario Veterinary College (OVC) for 25 years, and found her niche when she joined the OVC dermatology service in 2000. She eventually retired, but her passion for dermatology brought her back to referral work part-time at the V.A.D.E.R. Clinic in Morriston, Ontario. She was the fourth person to achieve RVT certification in Canada, is a charter member of the Academy of Dermatology Veterinary Technicians, and is currently the only VTS (Dermatology) in Canada. Jennie is also the only veterinary technician on the Executive Committee for the Canadian Academy of Veterinary Dermatology and is an author and international speaker in her area of expertise.

