Evaluation of dermoscopy in the diagnosis of naturally occurring dermatophytosis in cats

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Background – A rapid, accurate screening test for dermatophytosis in cats is desirable in clinical and shelter medicine. In human dermatology, dermoscopy is used to identify dermatophyte-infected hairs by their characteristic comma hair appearance. Similar “comma-like” hairs have been observed in infected cats.

Hypothesis/Objectives – The purpose of this study was to evaluate the usefulness of dermoscopy for the diagnosis of naturally occurring dermatophytosis compared to fungal culture.

Animals – A total of 67 cats were enrolled.

Methods – This was a descriptive field study. All cats were evaluated by dermoscopy and fungal culture. Dermoscopy was performed with a hand held nonpolarized light dermscope.

Results – Three dermatophyte pathogens were isolated via fungal cultures in 36 cats: Microsporum canis (n = 31), Microsporum gypseum (n = 3) and Trichophyton mentagrophytes (n = 2). Dermoscopy was positive in 21 of 36 cats with culture-confirmed dermatophytosis.

Conclusions and clinical importance – Dermoscopy may be a useful point-of-care-test to identify infected hairs to sample for dermatophyte cultures, but a definitive diagnosis for dermatophytosis should be based on clinical signs and the results of multiple diagnostic tests.

Introduction

Dermatophytosis is a pet-associated clinical disease that can be zoonotic. Early diagnosis is ideal in order to avoid the spread of disease and begin therapy as quickly as possible. Dermoscopy (dermatoscopy or epiluminescence microscopy) is a noninvasive technique using an illuminated camera that allows visualization of skin structures, which are invisible to the unaided eye.1,2 This diagnostic tool links microscopic histopathological evaluation with macroscopic clinical examination by magnifying skin lesions at the level of the hair follicle, epidermis, the dermoepidermal junction and the papillary dermis.2 Because dermoscopy can be performed with or without contact, it is well suited for veterinary medicine as well.

In human medicine, dermoscopy is used as a supplementary method for the differential diagnosis of tinea capitis.3,4 Characteristic comma and corkscrew hairs are associated with both ectothrix and endothrix types of fungal invasion.4,5 Hairs with multiple twists and coils are a result of partial damage to hair shafts filled with hyphae or damage to the hair cuticle.2,4,6 Both comma and corkscrew hairs have been documented in people with tinea capitis due to dermatophytes of the genera Trichophyton and Microsporum (Figure 1).4,6 A previous study described the dermoscopic features between cats with dermatophytosis and cats with self-induced alopecia due to other causes.6 “Comma-like” hairs are not found on healthy cats.6,7

The purpose of this study was to compare dermoscopy and fungal culture for the diagnosis of naturally occurring feline dermatophytosis.

Materials and methods

Study population

Sixty seven client-owned and shelter cats were enrolled in the study. Shelter cats were from multiple shelters in California, USA, and Galliate, Italy. To the knowledge of the shelters and owners, cats were not previously nor concurrently treated with antifungal therapy at the time of the study. Gross clinical pictures of all cats and their skin lesions were taken for documentation purposes. The only inclusion criterion was that the cat had to have at least one suspect dermatophyte lesion (crusts, alopecia, miliary dermatitis, scaling). Exclusion criteria were: previous diagnostic evaluation and/or any prior or concurrent oral or topical antifungal therapy. Cats were not excluded on the basis of age, breed, sex, lesion location or concurrent disease. All procedures were approved by shelters and written consent was obtained for all client-owned cats.

Dermoscopic examination

A hand held dermoscope DermLite®, DL3N (3Gen; San Juan Capistrano, CA, USA) that could toggle between polarized and nonpolarized light attached to an iPhone 5 (Apple Inc.; Cupertino, CA, USA) was used.8 Dermoscopic images were obtained by applying the glass plate of the dermoscope gently and directly to the lesion areas using...
a four-element 25 mm, 10× lens magnification. Images from at least two different angles and/or sites of the lesions were obtained with the iPhone camera that was attached to the dermoscope (Figure 2). Further magnification could be enhanced with the iPhone camera. Because infected dermatophyte hairs were the focus, only nonpolarized light without immersion oil was used in this study. Non-polarized dermoscopy without immersion fluid (dry dermoscopy) is suggested in order to better visualize hair and superficial skin lesions (e.g. scales). The dermoscope was disinfected with accelerated hydrogen peroxide 0.5% (Accel/C226 TB, Virox Technologies Inc.; Oakville, ON, Canada) and antibacterial gel 62% ethyl alcohol (Purell/C226, Gojo Industries Inc.; Akron, OH, USA) after each use and between each animal to prevent contamination. Because comma hairs in cats are not identical to comma hairs in humans, such hairs were interpreted as “comma-like.” If comma-like hairs were found on dermoscopy, patients were quantified as “positive”; they were “negative” if such hairs were not found.

Fungal culture evaluation
Hairs were plucked from the same location as lesions evaluated by dermoscopy. If “comma-like” hairs were present, those hairs were selected for fungal culture. If “comma-like” hairs were not present, then hairs were plucked from the lesional margins. Hairs were plucked using mosquito haemostats and inoculated onto enhanced Sabouraud’s Dextrose Agar and dermatophyte test medium (DTM) containing phenol red (pH indicator), antibiotics (gentamicin, chlorotetracycline) and cycloheximide (Shelby Scientific; Macomb, MI, USA). Haemostats were disinfected with accelerated hydrogen peroxide 0.5% (Accel/C226 TB) and antibacterial gel 62% ethyl alcohol (Purell/C226) after each use and between each animal to prevent contamination. The haemostats were wiped dry with a paper towel between each disinfectant.

Fungal cultures were incubated in an incubator Model12-240 (Quincy Lab Inc.; Chicago, IL, USA) at 30°C and 30% humidity for 21 days and assessed daily for growth, colony morphology, colony forming units, colour change, microscopy and macroconidia identification. Only lesioned cats were enrolled to prevent inclusion of fomite carrier cats (false positives), thereby ensuring that culture-confirmed cats had active disease at the time of evaluation. Hairs were obtained with a haemostat instead of the McKenzie toothbrush technique to reduce false positives resulting from a possible contaminated environment such as stray spores falling on the cat.

Results
Study subjects
A total of 67 cats were enrolled in the study. Clinical data on these animals is presented in Table S1 (Supporting information). Fifty four cats were from 11 different shelters; 13 were client-owned. Cat breeds included: 55 domestic short hair cats, six domestic long hair cats, five domestic medium hair cats and one Siamese mix. Twenty were intact female cats, 13 spayed female cats, 14 intact male cats and 20 neutered male cats. Ages ranged from 5 weeks to 16 years of age. Sedation was not required during the study.

Thirty six cats in the study were diagnosed with dermatophytosis based on fungal culture and all had active lesions. Twenty two cats were less than 1 year of age and 14 cats were 1 year of age or older. Ten of the cats were client-owned. Lesions were most commonly found on the ear margins, muzzle, periocular areas and distal thoracic limbs. Although dermatophytosis was variable in presentation, alopecia, scaling or crusting and erythema were the most commonly seen lesions.

Fungal culture
Three species of dermatophyte were grown on fungal culture based on colony morphology (colour, texture), macroconidia identification and microscopy (presence of coils, macroconidia, shape of hyphae): Microsporum canis, Microsporum gypseum and Trichophyton mentagrophytes. Thirty six cats grew a dermatophyte on fungal culture whereas 31 were negative. Microsporum canis was isolated from 31 cats; M. gypseum was isolated from two cats housed together and a third cat housed separately; T. mentagrophytes was isolated from two cats, both from the same shelter, but housed separately.

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Dermoscopy  
Twenty one of 36 culture confirmed cats had comma-like hairs identified by dermoscopy. Of the 31 cats that were culture positive for *M. canis* based on fungal culture, 19 cats were positive on dermoscopic examination. Two of three cats that were diagnosed with *M. gypseum* were positive on dermoscopy. Neither of the two cats diagnosed with *T. mentagrophytes* were identified on dermoscopy.

Of the 31 cats without culture confirmed dermatophytosis, ten cats had comma-like hairs on dermoscopy and 21 were negative by dermoscopy. Nine of 10 dermoscopy positive, culture negative cats had culture plates that were overgrown by *Aspergillus*, possibly masking true dermatophytosis. One of 10 cats did not have any growth on fungal culture.

Discussion  
The purpose of this study was to evaluate the usefulness of dermoscopy as a point-of-care test (POCT) for the diagnosis of naturally occurring dermatophytosis compared to fungal culture. Identification of comma-like hairs by dermoscopy provides immediate results to veterinarians while awaiting culture confirmation. Dermoscopy may be a useful tool to identify infected hairs to sample for dermatophyte culture. Definitive diagnosis for dermatophytosis should be based on clinical signs and the results of multiple diagnostic tests.

Comma-like hairs in cats appear differently than in humans. Most of the time the comma-like hairs appear opaque, broken, with a homogeneous thickness and a slight curve (Figure 3). Both humans and cats have a slight curve as a result of cracking and bending of hair shafts filled with fungal hyphae. Comma-like hairs were easier to identify in lighter cats than black cats; in black cats they still appear white or pale.

Dermoscopy may be a promising tool in veterinary medicine. The process of performing dermoscopic evaluations and taking pictures of each cat spanned between 10 s and 20 s per case. Dermoscopy has the advantage of identifying short infected hairs in areas that appear alopelic at the naked eye or missed by Wood’s lamp. In addition, dermoscopy may prove to have the ability to identify cats infected by a dermatophyte other than *M. canis*. To the best of the authors’ knowledge, this is the first study to identify cats infected with *M. gypseum* by dermoscopy. Dermoscopy could be a second POCT if Wood’s lamp does not reveal fluorescence.

The biggest challenge faced when using the dermoscope was patient cooperation. The cat needed to be motionless to allow enough time for the iPhone camera to focus and capture a picture of the comma hairs. Although noncontact dermoscopy could be performed to appreciate comma-like hairs, in general, contact between the cat and the dermoscope had to be achieved in order to obtain focused pictures, especially when the cat was not cooperative. A more rapid camera focus could potentially eliminate this problem. Another challenge is that the dermoscope can focus only on certain areas of the cat and cannot scan the overall animal like the Wood’s lamp. Use of dermoscopy to screen for dermatophytosis may also be dependent on the experience and skill of the examiner. In this study, the principal investigator performed all dermoscopy observations after receiving training in identification of comma hairs on known dermatophyte positive cats.

A difficulty in the diagnosis of naturally occurring dermatophytosis is the lack of a “gold standard.” Although culture confirmation is definitive for species identification, false positives can occur from samples collected from noninfected cats in a contaminated environment. Failure for pathogens to grow on media can result in false negative cultures and overgrowth of contaminant can confound diagnosis and delay therapy. Saprophytic contamination such as *Aspergillus* spp. is a common contaminant of dermatophyte cultures in clinical settings. Aspergillus sp. can grow rapidly and can outcompete *M. canis* on DTM or Sabouraud’s agar, resulting in false negatives. A heavily contaminated environment, improper temperature and moisture during incubation could all influence saprophytic overgrowth. Previous recommendations to reduce contaminant saprophytic overgrowth have included lightly swabbing hairs with 70% isopropyl alcohol-impregnated gauze or cotton and allowing air drying prior to collection. Such techniques may improve the reliability of fungal culture results. This technique was not evaluated in this study.

In this study, comma-like hairs were identified by dermoscopy in nine cases with no dermatophyte confirmed on fungal culture due to the overgrowth of...
contaminant (Aspergillus sp.) Based on these results dermoscopy was superior to fungal culture when Aspergillus sp. overgrowth was present. The occurrence of negative fungal cultures in clinically affected animals in practice is not uncommon. The clinician should not rely on a single screening test or culture. A diagnosis of clinical dermatophytosis is best based on the combination of physical examination, lesion evaluation and diagnostic tests: Wood’s lamp, direct examination, fungal culture, dermoscopy and PCR.

The main limitation in this study was that evaluation was limited to the initial visit with no additional follow-up. In clinical settings, additional visits, changes in lesions, multiple evaluations by screening tests, multiple cultures and response to therapy, all contribute to the final determination of disease state. Another limitation was that the majority of the cats were from animal shelters; as a consequence, the authors could not be certain that those cats had not been treated with any local or systemic antifungal agents prior to the study.

Future studies may assess the sensitivity and specificity of dermoscopy compared to the Wood’s lamp, direct examination and PCR testing. Larger numbers of cases using dermoscopy specifically to evaluate and compare M. gypseum and T. mentagrophytes should be considered because the numbers evaluated in this study were too low to reach definitive conclusions. Finally, additional studies could compare between polarized and non-polarized light dermoscopy, as well as contact and noncontact distance between the patient and the dermoscope, for selected skin lesions.

In conclusion, dermoscopic examination may be useful in identifying suspect hairs in animals that have lesions and when suspect hairs for direct examination and/or fungal culture are difficult to identify. In the shelter and clinical setting, the dermoscope may be helpful to identify high risk cats when other POCTs are not diagnostic. This can prevent those cats from entering a general population of cats or household and reduce the risk of contagion.

Acknowledgements

The authors would like to thank: Ken Chan, our clinical technician, as well as submitting veterinarians, including Furnie Yamamoto and Annie Li, and veterinary shelters that kindly provided us with clinical data; 3Gen for loaning the dermoscope used; and Antonella Tosti for human dermoscopic pictures.

References


Supporting Information

Additional Supporting Information may be found in the online version of this article.

Table S1. Clinical data for dermoscopic and fungal culture evaluations.

Résumé


Hypothèses/Objectifs – Le but de cette étude était d’estimer l’utilité de la dermoscopie pour le diagnostic d’une dermatophytose d’origine naturelle comparé à la culture fongique.
Sujets – Un total de 67 chats a été enroîlé.

Méthodes – Il s’agissait d’une étude descriptive. Tous les chats ont été évalués par dermoscopie et culture fongique. La dermoscopie a été réalisée par un dermatoscope manuel à lumière non polarisée.

Résultats – Trois dermatophytes pathogènes ont été isolés par culture fongique chez 36 chats : Microsporum canis (n = 31), Microsporum gypseum (n = 3) et Trichophyton mentagrophytes (n = 2). La dermoscopie a été positive pour 21 des 36 chats avec diagnostic confirmé par culture.

Conclusions et importance – La dermoscopie peut être utile en test de terrain pour identifier les poils infectés à prélever pour les cultures fongiques, mais un diagnostic définitif de dermatophytose doit être basé sur les signes cliniques et les résultats de tests diagnostiques multiples.

Resumen

Introducción – Sería deseable tener una prueba rápida y efectiva de detección de dermatofitosis en medicina veterinaria de refugios para gatos. En dermatología humana la dermoscopia se utiliza para identificar pelos infectados con dermatofitos por su característica forma de coma. Una forma similar parecida a una coma se ha observado en los pelos de gatos infectados

Hipótesis/Objetivos – El propósito de este estudio fue evaluar la utilidad de la dermoscopia para el diagnóstico de dermatofitosis de ocurrencia natural comparada con el cultivo fúngico

Animales – Se incluyeron un total de 67 gatos.

Métodos – Este fue un estudio de campo descriptivo. Todos los gatos se evaluaron mediante dermoscopia y cultivo fúngico. La dermoscopia fue desarrollada con un dermoscopio manual de luz no polarizada.

Resultados – Tres patógenos dermatofíticos fueron aislados mediante cultivos fúngicos en 36 gatos: Microsporum canis (n = 31), Microsporum gypseum (n = 3), y Trichophyton mentagrophytes (n = 2). La endoscopia fue positiva en 21 de los 36 gatos con dermatofitosis confirmada por cultivo.

Conclusión e importancia clínica – La dermoscopia puede ser una prueba de utilidad de primeros cuidados para identificar los pelos infectados a utilizar en cultivos de dermatofitos, pero el diagnóstico definitivo de dermatofitosis debe basarse en los signos clínicos y el resultado de múltiples pruebas diagnósticas.

Zusammenfassung


Hypothese/Ziele – Das Ziel dieser Studie war eine Evaluierung der Nützlichkeit der Dermoskopie zur Diagnose einer natürlich auftretenden Dermatophytose im Vergleich zur Pilzkultur.

Tiere – Es wurden insgesamt 67 Katzen einbezogen.


Ergebnisse – Bei 36 Katzen wurden drei pathogene Dermatophyten mittels Pilzkultur isoliert: Microsporum canis (n=31), Microsporum gypseum (n=3) und Trichophyton mentagrophytes (n=2). Die Dermoskopie war bei 21 von 36 Katzen positiv und wurde mit einer Kultur als Dermatophytose bestätigt.

Schlussfolgerungen und klinische Bedeutung – Die Dermoskopie könnte ein nützlicher Point-of-Care Test (patientennahe Labortest) sein, um infizierte Haare zur Verwendung in der Pilzkultur zu identifizieren, aber eine definitive Diagnose für eine Dermatophytose sollte aufgrund klinischer Zeichen und aufgrund der Ergebnisse multipler diagnostischer Tests erfolgen.

要約

背景 – ネコにおける皮膚系状菌症の迅速かつ正確なスクリーニング検査が臨床および予防医学的に必要となって いる。ヒトの皮膚科においては、特徴的なコッラ状に矢印した外見によって皮膚系状菌に感染した歯毛を特定するためにダーマスコピー（皮膚拡大鏡）を使用している。感染した歯において同様の“コッラ状に矢印したような”被毛の観察を行っ た。

仮説/目的 – 研究の目的は真菌培養と比較して、自然発症の皮膚系状菌症の診断に対するダーマスコピーの有用 性を評価することである。

動物 – 総数67頭の筋を組み入れた

方法 – これは記述的フィールド研究である。全てのネコをダーマスコピーおよび真菌培養により評価した。ダーマスコピー は携帯型非偏光ダーマスコピーを用いて行った。

結果 – 36頭の2%から真菌培養で3種の病原体が分離された。31頭がMicrosporum canis 3頭がMicrosporum gypseum 2頭がTrichophyton mentagrophytesであった。ダーマスコピーでは真菌培養で“陽性で あった36頭中、21頭が陽性であった。

結論および臨床的な重要性 – ダーマスコピーは真菌培養のための感染被毛の特定に、現場でできる有用な検査か もれえないが、皮膚系状菌症の確定診断は臨床検査や複数の診断的な検査の結果を基に行うべきである。

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**摘要**

**背景** — 猫癣菌病无论对于临床还是救助医疗, 都需要一种快速、精确的检测方法。在人类皮肤病领域, 皮肤镜下毛发外观呈现为逗号特征, 可借此鉴别癣菌感染。患病猫的毛发可发现相似的“逗号样”毛发。

**假设/目的** — 这项研究的目的为, 通过与真菌培养相比, 评估皮肤镜检查法诊断自然感染的癣菌病的可行性。

**动物** — 征集67只猫。

**方法** — 这是一项描述性实地研究, 所有猫进行皮肤镜检查和真菌培养。检测用的皮肤镜为一种手持的非偏光性皮肤镜。

**结果** — 36只猫通过真菌培养法分离出3种癣菌病原体, 大卵孢子菌(n = 31)、石膏样小孢子菌(n = 3) 和须毛癣菌(n = 2)。真菌培养确诊的36只患猫中, 有21只猫的皮肤镜检查结果为阳性。

**总结和临床意义** — 皮肤镜鉴别感染毛发相较于真菌培养来说, 可能是一种有用的即时检测手段, 但是关于癣菌病的确诊, 应该基于临床症状和多项诊断试验的结果。