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Histomorphological studies on hair follicular tumours in dogs

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Abstract

Hair follicular tumours (HFTs) are a relatively uncommon group of neoplasms in dogs, originating from the hair follicle structures. During the study period, 100 samples of tumour-suspected cutaneous masses were collected from dogs across the state of Kerala, India. The biopsy samples were screened histologically by routine haematoxylin and eosin staining. Immunohistochemistry and special histological staining were employed when required. Nine cases of HFTs were identified, of which six cases were trichoblastoma, two pilomatricoma and one trichofolliculoma. The study provided an overview of the occurrence of HFTs, including breed, sex, and anatomical location, along with details of their clinical characteristics, gross and microscopic pathology.

Keywords: *Hair follicular tumour, trichoblastoma, pilomatricoma, trichofolliculoma, dog*

Hair follicles (HFs) are dynamic skin appendages critical for cutaneous homeostasis, wound healing, and aesthetic maintenance. Beyond their physiological roles, HFs can give rise to a spectrum of neoplastic proliferations due to dysregulated follicular stem cell activity or signalling pathways. These tumours, ranging from benign lesions (e.g., trichoepitheliomas) to rare malignant variants (e.g., trichilemmal carcinomas), exhibit diverse histomorphological features, reflecting their origin from aberrant differentiation of HF-derived keratinocytes. Although less prevalent in canine species compared to other cutaneous neoplasms (Kok *et al*., 2019), their accurate histopathological classification remains essential for diagnostic precision.

Although canine hair follicle tumours are frequently encountered in clinical practice, their morphological resemblance to various benign and malignant neoplasms may lead to diagnostic confusion, potentially affecting clinical decision-making and prognosis. Furthermore, studies on the occurrence and detailed characterisation of the morphological variants in the region are scarce. This study evaluated the epidemiological distribution and pathological spectrum of canine hair follicle tumours, providing insights into their diagnostic criteria and morphological diversity.

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Materials and methods

One hundred excisional biopsy specimens suspected to be cutaneous tumours were collected from dogs across the state of Kerala, India. Detailed clinical data, including patient age, sex, breed, and anatomical location of each tumour, were documented for all cases. Following collection, tissue samples were immediately fixed in 10% neutral buffered formalin for optimal preservation. The fixed specimens underwent standard tissue processing through graded alcohol dehydration, xylene clearing, and paraffin embedding. Serial sections of 5 µm thickness were cut using a precision microtome for histological examination.

For comprehensive histopathological evaluation, tissue sections were stained with routine hematoxylin and eosin (H&E) stains for general morphological assessment. Additional sections were stained with Masson's trichrome stain (MTC) to evaluate connective tissue components and stromal patterns, following established protocols (Sharif and Reinacher, 2006). In cases requiring further diagnostic clarification, immunohistochemical analysis was performed using pan cytokeratin markers (Ms X Cytokeratin AE1/AE3, EMD Millipore, USA) (Kok *et al*., 2019) to confirm epithelial differentiation and aid in tumour classification.

The histological sections were systematically evaluated by light microscopy. Tumours were classified based on a combination of histomorphological characteristics, including cellular architecture, differentiation patterns, stromal interactions, and their respective staining properties. Special attention was given to diagnostic features observed in both routine and special staining of tissue sections to ensure accurate tumour categorisation.

Results and discussion

The study identified 90 skin tumours among 100 suspected cases examined, with HFTs diagnosed in nine cases (10% of total tumours). This prevalence was slightly lower than the 12.34% reported in Swiss canine populations by Graf *et al.* (2018). The tumours were identified in German Shepherd (GSD) (n=2), Shih Tzu (n=2), Beagle (n=3), Spitz (n=1) and non-descript (n=1) dogs. Males represented two-thirds of cases (6/9), and cases clustered in either very young (<2 years) or middle-aged (5-9 years) dogs. The predominance of males may reflect the local preference for rearing male dogs. Anatomically, tumours showed strong preference for axial locations, with 88.9% (8/9) occurring along the head/neck (55.6% of them particularly in mandibular and lateral neck regions), thorax, lumbar area, and tail, while only two cases involved appendicular structures (forelimb), consistent with findings by Sharma *et al*. (2022). Breed-specific tendencies emerged, with Shih Tzu cases occurring in younger dogs and atypical locations (tail, limbs), while GSD and Spitz cases clustered in older dogs and cranial regions. However, due to the limited sample size, definitive conclusions regarding breed predisposition cannot be drawn from the present study. The clinical details of the cases and the anatomical location of different types of tumours are depicted in table 1.

Gross appearance

The HFTs typically were presented as well-circumscribed, round to elliptical masses with a firm consistency on palpation, suggestive of a dense fibrous composition. In two cases (22.2%), superficial ulcerations were noted (Fig. 1). On sectioning, the tumours revealed a predominantly white, lobulated cut surface, indicative of organised internal architecture. A single case (11.1%) demonstrated focal yellow discolouration, potentially reflecting areas of cystic degeneration or lipid accumulation. The uniform firmness observed across all specimens correlated with their well-demarcated gross appearance similar to that mentioned by Meuten (2017). The key findings revealed that trichoblastomas in dogs exhibited firm, white lobulated cut surfaces, consistent with previous reports (de Souza *et al.,* 2020), while trichofolliculomas presented as nodules containing sebaceous material, and pilomatricomas appeared as solitary, often mineralised masses similar to the observations of Rissi (2019).

In both cases of pilomatricomas, dome-shaped nodules of variable size were observed (Fig. 2), and in one

Table 1. Clinical parameters, anatomical location and types of hair follicular tumour in dogs

Sl. No.	Breed	Age	Sex	Anatomic location of tumour	Type of hair follicular tumour
1	Shih Tzu	<2 yrs	M	Tail	Pilomatricoma
2	Shih Tzu	2 yrs	F	Forelimb	
3	Non-descript	7 yrs	F	Lateral Neck	Trichoblastoma
4	GSD	5 yrs	M	Cheek	
5	GSD	9 yrs	M	Head, Mandibular region	
6	Spitz	8 yrs	M	Head	
7	Beagle	3 yrs	M	Fore limb	
8	Beagle	9 M	F	Lumbar region	
9	Beagle	5 yrs	M	Flank, thorax	Trichofolliculoma

case the cut surface was horny, making the mass difficult to cut. In case of trichofolliculoma, two well-circumscribed small nodules on the skin with sebaceous secretions were noticed (Fig. 3).

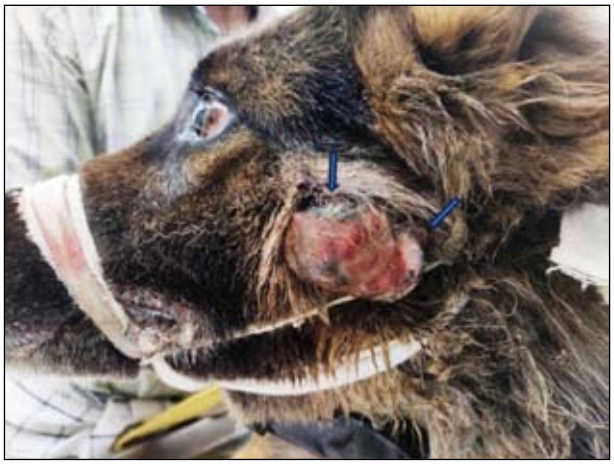

Fig. 1. German Shepherd Dog-Trichoblastoma. Well-circumscribed firm, nodular, flesh-coloured tumour nodule (arrows) with ulceration on the left cheek (arrow).

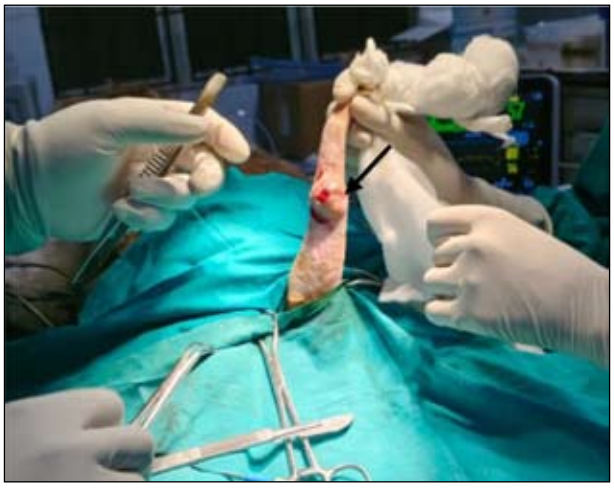

Fig. 2. Shih Tzu dog- Pilomatricoma. Firm nodular mass (arrow) on the ventral aspect of the tail.

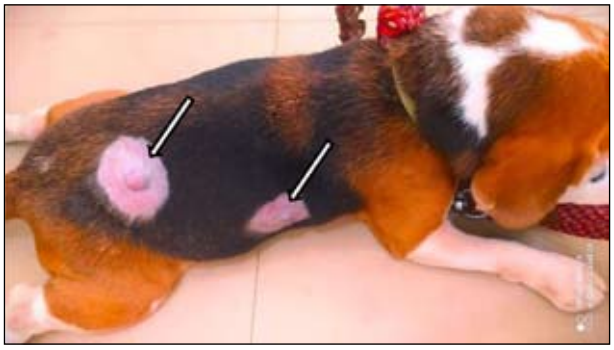

Fig. 3. Beagle dog-Trichofolliculoma. Two well-circumscribed round masses (arrows) of trichofolliculoma on the flank region and ventro-lateral thorax.

Histopathology

The histopathological examination of nine canine HFTs revealed six trichoblastomas (66.7%), two pilomatricomas (22.2%), and one trichofolliculoma (11.1%). According to Abramo *et al.* (1999), the most prevalent HFTs in dogs are trichoblastomas, followed by trichoepitheliomas, pilomatricomas, and infundibular keratinising acanthomas. Trichoblastomas observed in the current study exhibited two distinct morphological patterns: the more common ribbon-type (4/6 cases) showed characteristic 2-3 cell-thick cords arranged in parallel strands with scant eosinophilic cytoplasm and prominent nuclei, embedded within a collagen-rich stroma (Fig. 4). Gross *et al*. (2005) also reported predominance of this histological type among the HFTs in dogs. The medusoid variant (2/6 cases) demonstrated a similar pattern described by Bharathi *et al.* (2025), where central cellular aggregates with radiating eosinophilic cell cords (Fig. 5) were observed. The pilomatricomas displayed their diagnostic lobular architecture, featuring basaloid cells and anuclear ghost cells, with one case showing dystrophic calcification and osseous metaplasia (Fig. 6), supporting their origin from hair matrix keratinocytes and the frequent association with mineralisation processes. Rissi (2019) also noted mineralisation and bone formation in a canine pilomatricoma case. In trichofolliculoma, multiple dilated HFs containing fragments of keratin could be seen. Additionally, secondary follicles along with a few clusters of sebocytes were present (Figs. 7 and 8), similar to the description by Wiener (2021).

The major histological differentiating characters between the three HFTs is that, trichoblastomas displayed characteristic palisading epithelial cords within a stromal framework (Mineshige *et al*., 2014), whereas trichofolliculomas contained dilated follicles with keratin debris and sebocyte clusters (Scott and Anderson, 1991). Whereas, pilomatricomas frequently show “ghost”

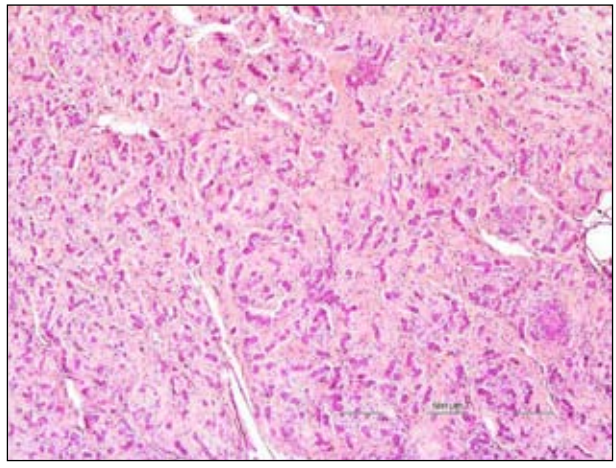

Fig. 4. Trichoblastoma- Ribbon type: Ribbon-like pattern formed by 2-3 cell thickness basaloid cells with abundant collagenous stroma (H&E, x100)

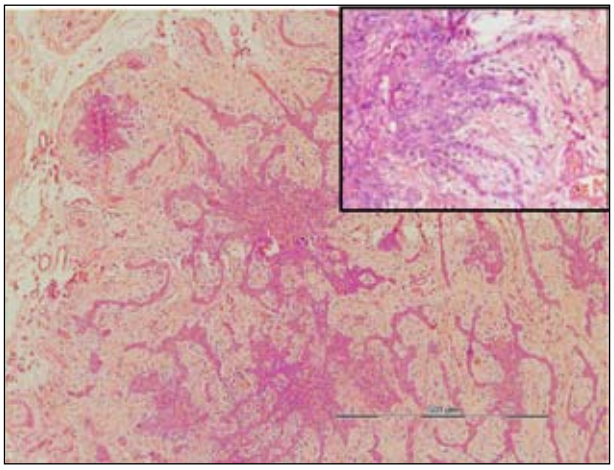

Fig. 5. Trichoblastoma- Medusoid type: Basaloid cells forming cords arising from central islands (H&E, x100). Inset- Higher magnification showing basaloid cells forming cords (H&E, x400).

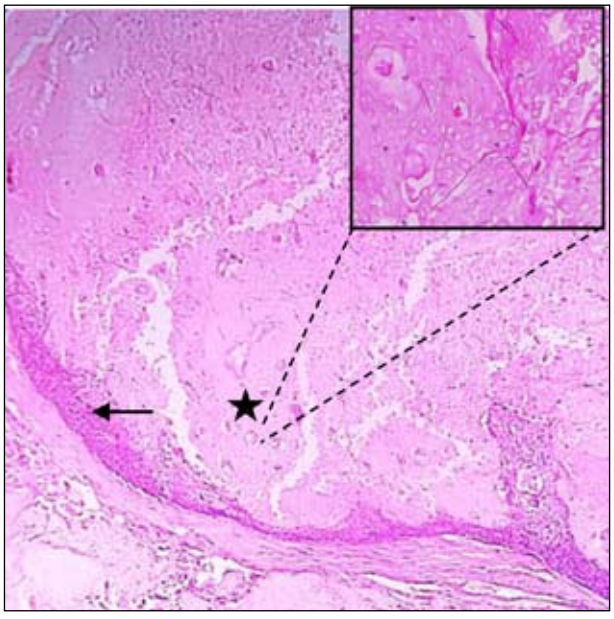

Fig. 6. Pilomatricoma: Matrical differentiation with peripheral basaloid cells (arrow) and central ghost cell (asterisk) (H&E, x100). Inset- Higher magnification showing ghost cells (H&E, x400)

or "shadow" cells along with basaloid cell proliferation, even though these features are recognised as markers of follicular differentiation rather than pathognomonic signs (Sells and Conroy, 1976; Headington, 1976).

Special staining with MTC revealed a distinct pattern of collagen deposition with the blue-stained fibrous stroma surrounding the red-stained tumour nest, and was more evident in trichoblastomas, since these tumours have both epithelial and mesenchymal components as described by Marusic and Calonge (2020) differentiating it from the other epithelial or basaloid cell tumours. The staining of collagen further helps in assessing the density

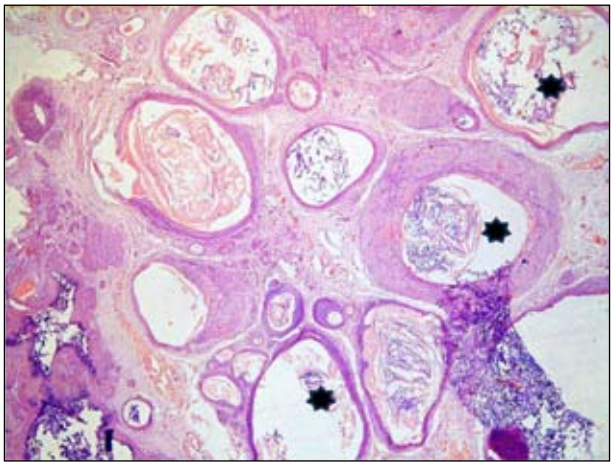

Fig. 7. Trichofolliculoma: Multiple dilated follicles (asterisk) with keratin fragments and surrounding collagenous stroma (H&E, x100)

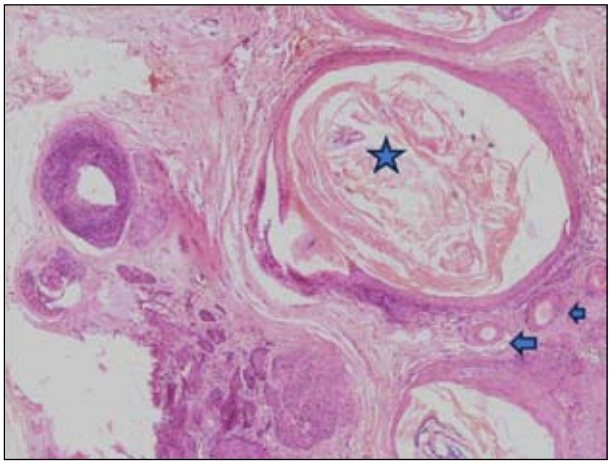

Fig. 8. Trichofolliculoma: Dilated primary follicle (asterisk) with small secondary follicles (arrows) (H&E, x400)

and organisation of a tumour's fibrous stroma (Fig. 9).

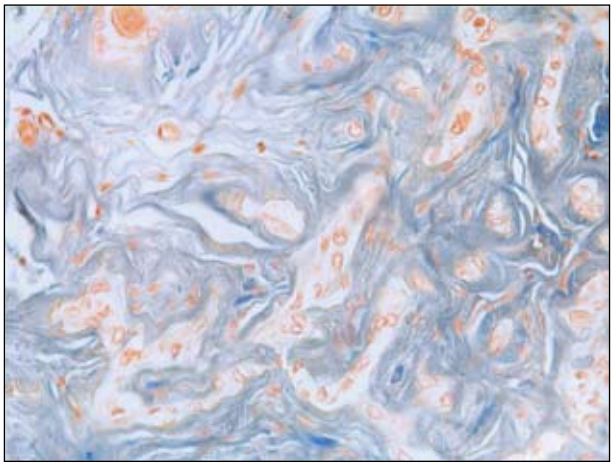

Fig. 9. Trichoblastoma: Extensive blue-stained collagenous stroma surrounding scattered islands of red-stained epithelial tumour cells (MTC, x400)

Immunohistochemistry

Pancytokeratin immunohistochemistry staining demonstrated a strong and consistent cytoplasmic positivity in epithelial cells of HFTs. Pancytokeratin staining was evident in basaloid cells in follicular tumours. The differential staining pattern helps in identifying and classifying HFTs by confirming their origin (Fig. 10).

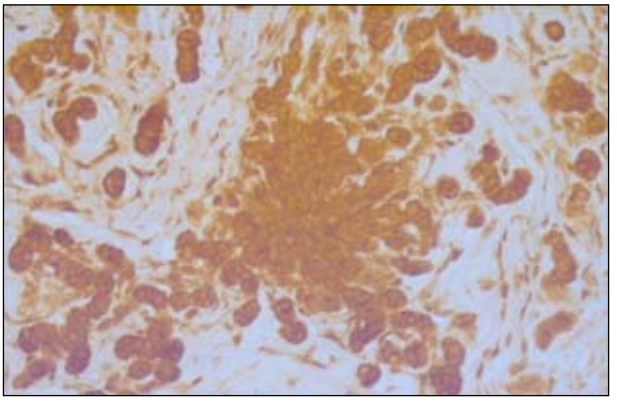

Fig. 10. Trichoblastoma: Pancytokeratin cytoplasmic staining (IHC, x400)

These findings align with existing veterinary and human medical literature, reinforcing the concept that canine HFTs share significant histomorphological overlap with their human counterparts. However, while human trichoblastomas have been reported to exhibit malignant potential (Cowen *et al.,* 2000), canine cases in this study remained benign, suggesting possible species-specific differences in tumour behaviour. The consistency of our observations with prior studies supports the reliability of current diagnostic criteria but also underscores the need for further comparative studies to clarify biological variations.

Conclusion

The present study underscores the value of detailed histomorphological evaluation in the diagnosis of dog HFTs. The characterisation of trichoblastomas, pilomatricomas, and trichofolliculomas based on gross, microscopic, and immunohistochemical features facilitates accurate classification and aids in differentiating these benign neoplasms from malignant cutaneous tumours with overlapping morphology. Such a distinction is critical for guiding appropriate clinical management and preventing misdiagnosis. The findings also provide anatomic and region-specific data on tumour distribution and presentation, contributing to a broader understanding of HF skin tumour pathology in dogs.

Acknowledgements

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Conflict of interest

The authors declare that they have no conflict of interest.

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