RESEARCH PAPER

Dermal Adnexal Neoplasms: Exploring Rare Variants and Their Clinical Behavior

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ABSTRACT

Background: Skin adnexal tumors (SATs) are rare growths that come from the skin's pilosebaceous and sweat gland structures. Their various forms and similarities to other skin lesions make clinical diagnosis tricky. Therefore, histopathology is crucial for accurate identification and prognosis.
Aim: This study aims to examine the clinicopathological features, anatomical distribution, and differentiation lineage of rare skin adnexal tumors at a tertiary care hospital.
Methods: A retrospective study included 42 histopathologically confirmed SAT cases diagnosed between 2022 and 2024. We evaluated tumors for demographic features, anatomical location, histological subtype, and classified them as benign or malignant.
Results: Follicular tumors were the most common at 42.9%, followed by sweat gland tumors at 40.5% and sebaceous tumors at 11.9%. Pilomatricoma was the most frequent benign lesion at 33.3%. Rare malignant tumors included adenoid cystic carcinoma, eccrine mucinous carcinoma, and high-grade malignant trichilemmal tumor. Malignancies accounted for 7.1% of the cases.
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INTRODUCTION

Skin adnexal tumors (SATs) are a varied group of neoplasms that originate from the epidermal appendages, including the pilosebaceous unit, which consists of hair follicles and sebaceous glands, as well as eccrine and apocrine sweat glands. These structures are important for skin functions such as hair growth, sebum production, and regulation of body temperature through sweating. SATs can show a wide range of histological differentiation that reflects the complex makeup of these appendages.

Though relatively rare, SATs present significant diagnostic challenges for both clinicians and pathologists. Their infrequency often results in limited familiarity and experience. Additionally, their clinical presentations frequently resemble those of more common benign skin lesions like cysts, warts, or inflammatory nodules. This similarity can lead to misdiagnosis or delayed diagnosis when relying solely on clinical examination.

Most SATs are benign tumors that grow locally and generally have a good prognosis after removal. However, some can be malignant, displaying aggressive behavior, local invasion, recurrence, and potential for metastasis. Although malignant adnexal tumors are uncommon, they can result in serious health issues if not identified and treated quickly.

Because of these challenges, accurate diagnosis and classification of SATs require thorough histopathological examination that details architectural and cytological features. Additional techniques such as immunohistochemistry can help classify difficult cases, especially in distinguishing benign from malignant lesions with similar appearances. An accurate histopathologic diagnosis is essential to guide treatment, assess prognosis, and identify cases that may be associated with hereditary syndromes that have broader health implications, like Muir-Torre or Cowden syndromes.

The rarity of these tumors, their resemblance to other skin lesions, and their various histopathological features call for careful pathological evaluation for effective diagnosis, treatment planning, and prognosis assessment.

MATERIALS AND METHODS

The retrospective study took place at Sree Balaji Medical College and Hospitals, Chrompet, over two years from 2022 to 2024. We gathered clinical information such as patient age, gender, lesion location, and clinical diagnosis by reviewing medical records and histopathology reports. All included cases had histopathologically confirmed skin adnexal tumors, while lesions not related to adnexal structures, such as other epidermal or soft tissue tumors, were excluded.

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We obtained ethical approval for the study from the institutional ethics committee before data collection and analysis, ensuring ethical standards were met during the research. We systematically analyzed the data to outline the clinicopathological features and distribution patterns of skin adnexal tumors in the studied population.

We processed tissue samples using standard histological methods. Sections were stained with hematoxylin and eosin (H&E) to assist with microscopic evaluation. We carefully assessed and classified each tumor based on its primary lineage of differentiation into follicular, sweat gland (eccrine and apocrine), or sebaceous origin. Furthermore, we categorized tumors as benign or malignant according to established histopathological criteria.

STATISTICAL ANALYSIS

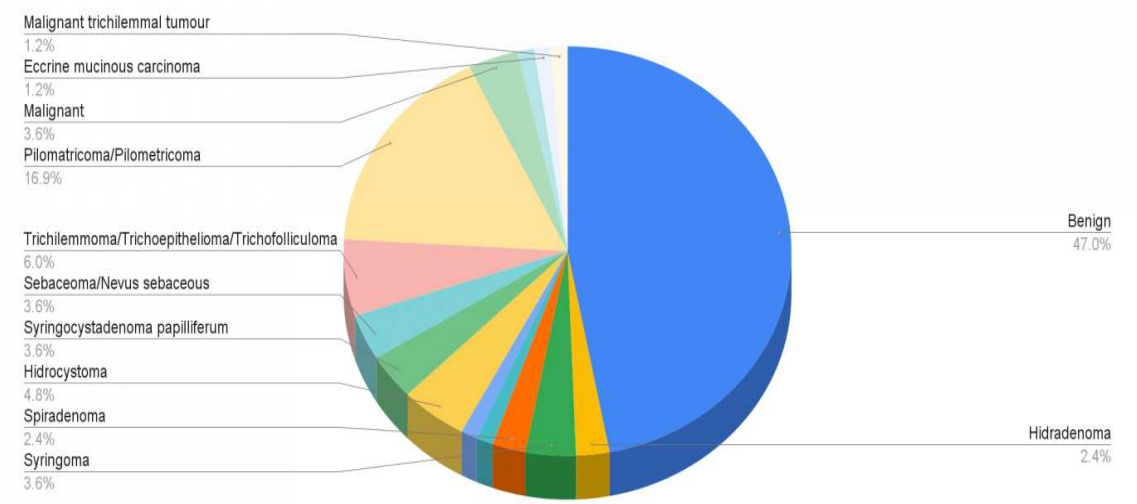
We performed frequency and percentage calculations based on the collected data.

RESULTS

A total of 42 cases met the inclusion criteria. The demographic data showed that patient ages ranged from 8 to 76 years. Follicular tumors made up the largest group at 42.9%, followed by sweat gland tumors at 40.5% and sebaceous tumors at 11.9%.

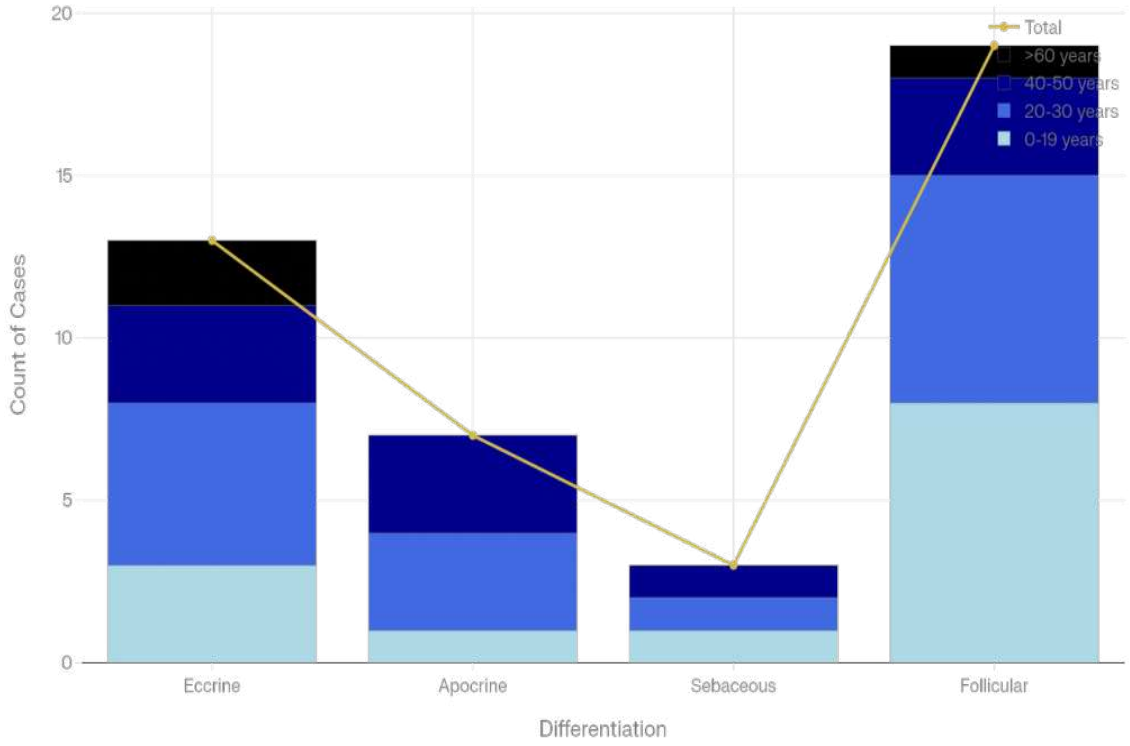
The following section discusses skin adnexal tumors (SATs) in detail based on the collected data and the requested format, covering epidemiology, clinicopathological features, diagnostic challenges, and prognosis, integrating findings from multiple studies to provide depth and clarity.

Tumour type	0-19 years (n)	20-39 yrs (n)	40-59 yrs (n)	>60 yrs (n)	Grand Total (n)	Male: Female (Ratio)
Benign	9	17	9	2	39	1:1.1
ECCRINE						
Hidradenoma	0	2	0	0	2	2F
Syringoma	0	3	0	0	3	1:2
Spiradenoma	0	2	0	0	2	1:1
Cylindroma	0	0	1	0	1	1F
Chondroid Syringoma	0	1	0	0	1	1M
APOCRINE						
Hidrocystoma	0	3	1	0	4	3:1
Syringocystadenoma papilliferum	1	0	2	0	3	3F
Sebaceous						
Nevus sebaceous	1	1	0	0	2	1:1
Sebaceoma	0	0	1	0	1	1M
Follicular						
Trichilemmoma/Trichoepithelioma/Trichofolliculoma	0	1	3	0	5	1:4
Pilomatricoma/Pilometricoma	7	5	0	1	14	1:1
Malignant	0	0	2	1	3	1:2
Eccrine						
Adenoid Cystic Carcinoma	0	0	1	0	1	1M
Eccrine mucinous carcinoma	0	0	1	0	1	1F
Follicular						
Malignant trichilemmal tumour	0	0	0	1	1	1F
Dataset Total	9	22	12	3	42	1:1.2



Line	Benign (n)	Malignant (n)	Total (n)	% of 42 cases
Eccrine	**11**	**2**	**13**	**30.95**
Apocrine	**7**	**0**	**7**	**16.67**
Sebaceous	**3**	**0**	**3**	**7.14**
Follicular	**19**	**1**	**20**	**47.62**
Total	**40**	**3**	**43***	**100**

TUMOUR TYPE AGE WISE DISTRIBUTION AND ITS LINE OF DIFFERENTIATION



Distribution of Tumour of Epidermal Appendages with respect to Anatomical Site

Tumour Type	Head and Neck	Extremities and Trunk	Total
BENIGN	20	19	39
Follicular Differentiation	7	11	18
Pilomatricoma	5	10	15
Trichilemmoma	0	1	1
Trichoepithelioma	1	0	1
Trichofolliculoma	1	0	1
Sebaceous Differentiation	3	0	3
Nevus sebaceous	2	0	2
Sebaceoma	1	0	1
Apocrine Differentiation	3	2	5
Syringocystadenoma papilliferum	1	1	2
Hidrocystoma	2	1	3
Eccrine Differentiation	7	6	13
Syringoma	1	2	3
Hidradenoma	5	1	6
Spiradenoma	0	2	2
Cylindroma	0	1	1
Chondroid Syringoma	1	0	1
MALIGNANT	0	3	3
Follicular Differentiation	0	1	1
High-grade Malignant Trichilemmal Tumor	0	1	1
Eccrine Differentiation	0	2	2
Eccrine Mucinous Carcinoma	0	1	1
Primary Cutaneous Adenoid Cystic Carcinoma	0	1	1
Grand Total	**20**	**22**	**42**

RESULTS

During the study period from 2022 to 2024, out of 6000 biopsies a total of 42 cases of skin adnexal tumors were identified. Among these patients, 25 were females and 17 were males, showing a slight female predominance with a male-to-female ratio of 1:1.47.

The ages ranged from 8 to 76 years. Most cases occurred in the 20–39 year age group (52.38%), followed by patients aged 40–59 years (28.57%). The 0–19 year age group accounted for 21.43% of cases, while only 7.14% of tumors were seen in patients aged 60 years and above.

Malignant tumors were uncommon and were noted mainly in individuals above 40 years of age.

Out of the total 42 cases, 39 cases (92.86%) were benign, while 3 cases (7.14%) were malignant.

Based on histogenetic differentiation, tumors of follicular origin formed the largest group (45.24%), followed by tumors arising from sweat glands including eccrine and apocrine differentiation (47.62%). Sebaceous tumors were relatively less common, comprising 7.14% of the total cases.

Among the benign tumors, pilomatricoma was the most frequently observed lesion (35.71%), affecting a wide range of age groups. This was followed by hidradenoma and syringoma (7.14% each), while spiradenoma and hidrocystoma (4.76% each) were less commonly encountered.

Most tumors showing follicular and sweat gland differentiation were benign in nature. The malignant tumors encountered in the present study 3 of 42 cases (7.14%), with all occurring exclusively in patients over 40 years of age, this included adenoid cystic carcinoma, eccrine mucinous carcinoma, and one additional malignant adnexal tumor, highlighting the rarity of malignant transformation in adnexal neoplasms.

Notably, these demonstrated a female predominance (2:1) and favored trunk/extremity sites, diverging from the head/neck/scalp predilection typical of benign counterparts. Histogenetically, two were eccrine-derived

while one represented follicular differentiation, underscoring diverse origins. Such findings emphasize the critical need for meticulous histopathological scrutiny of atypical adnexal lesions in middle-aged and elderly patients, particularly at non-classic sites. Our observed 7.14% malignancy rate aligns closely with contemporary literature, highlighting both their diagnostic subtlety and clinical import.

The anatomical distribution of skin adnexal tumors, the head and neck region was the most commonly involved site, accounting for 47.62% (20/42) of cases. This was followed by tumors occurring in the extremities and trunk, which together comprised 52.38% (22/42) of cases.

1. **Follicular Tumors**

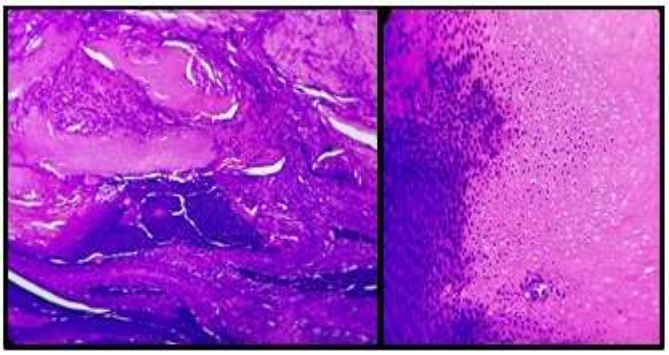


Fig 1.1 - Pilomatricoma

Fig 1.1A H&E (10x) - Well circumscribed and biphasic with Islands of basaloid cells, with calcification and foreign body giant cell reaction

Fig 1.1B H&E (40x) - Islands of basaloid cells with central “ghost” or “shadow” cells lacking nuclei

2. **Trichofolliculoma**

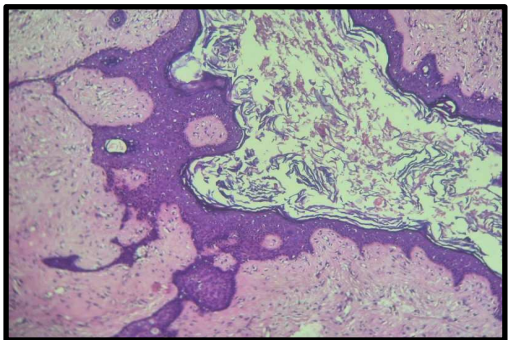


Fig 1.2. Trichofolliculoma

Fig 1.2A H&E (10x) - Shows a central, keratin-filled cystic cavity lined by stratified squamous epithelium. Numerous secondary hair follicles of various stages radiate from the cyst wall into the dermis. No atypia or malignant changes are seen.

3. **Trichoepithelioma**

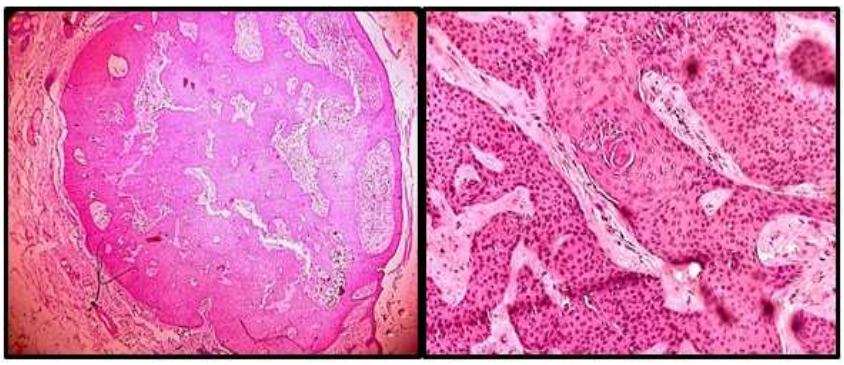


Fig 1.3. Trichoepithelioma:

Fig 1.3A H&E (10x) Fig 1.3B H&E (40x) - Well-circumscribed dermal tumor with epithelial and stromal components, horn cysts (keratin-filled cysts) within basaloid epithelial islands, Tumor islands of basaloid cells show peripheral palisading, often with a central area of keratinization, Islands are surrounded by a fibrocellular stroma, Absence of clefting around tumor islands helps distinguish from basal cell carcinoma, No significant cytologic atypia or mitoses.

4. **Trichilemmoma**

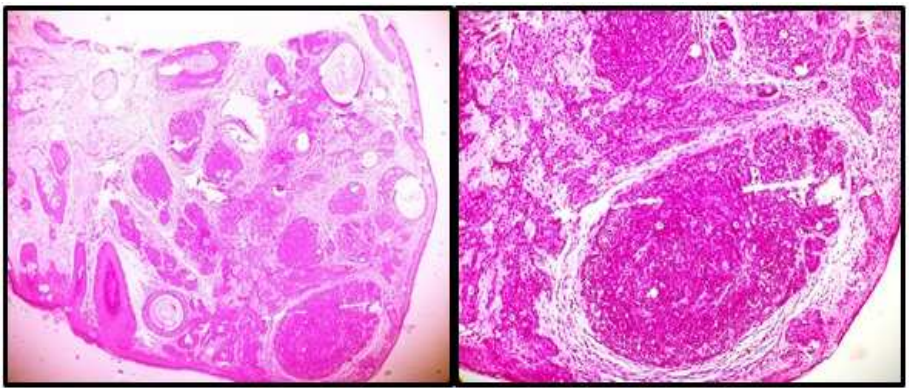


Fig 1.4. Trichilemmoma

Fig 1.4A H&E (10x)Fig 1.4B H&E (40x) - Lobular proliferation of pale glycogen-rich cells with peripheral palisading and thickened basement membrane, continuous with epidermis, lacking atypia.

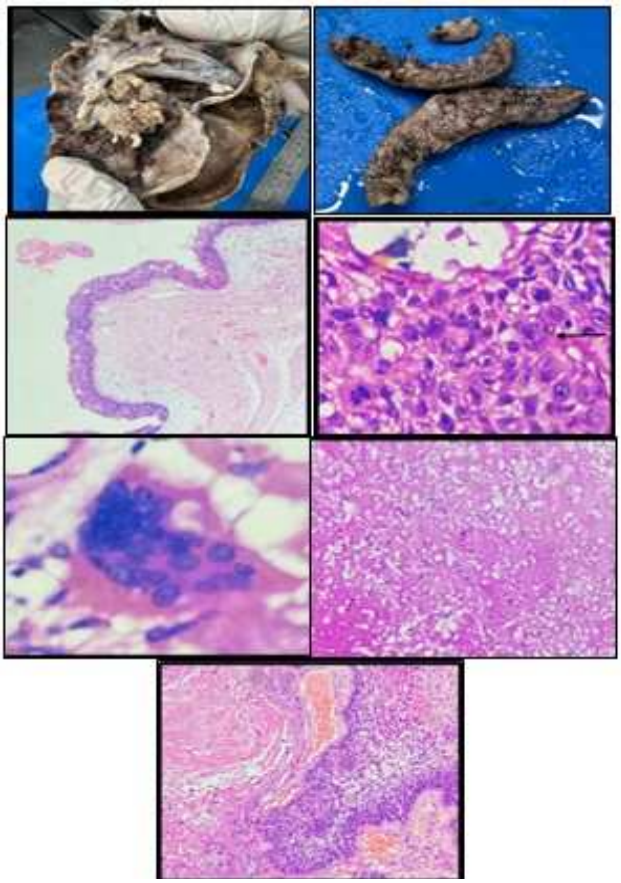


Fig 1.5. High Grade Malignant Trichilemmal Tumor

Fig 1.5A &Fig 1.5B - Multiple fragments of grey brown cystic mass with focal friable papillary projection.

Fig 1.5C H&E (10x)- cyst wall showing trichilemmal cyst lining.

Fig 1.5D H&E (40x)- Atypical mitosis.

Fig 1.5E H&E (40x)- Giant cells.Fig 1.5F H&E (10x) - Necrosis.

Fig 1.5G H&E (10x)- cyst wall showing abrupt keratinisation.

1. **Cylindroma (Fig 2.1)**

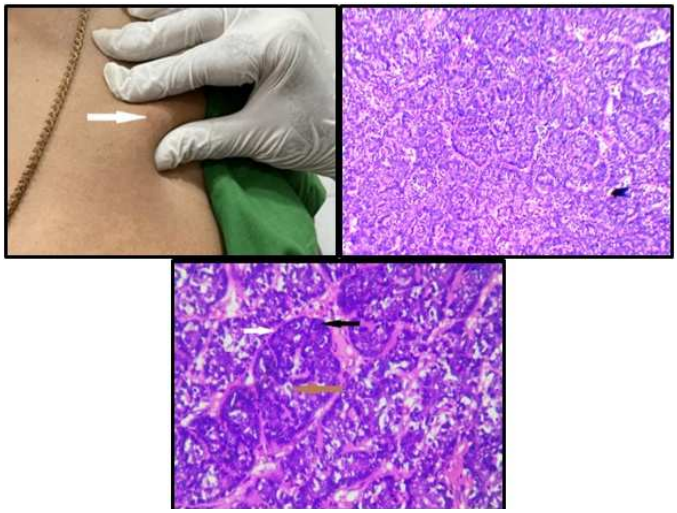


Fig 2.1: Cylindroma.

Fig 2.1A - Gross: pink to red nodules -1.5cm.

Fig 2.1B H&E (10x) & (40x) - Nests of basaloid cells arranged like a "jigsaw puzzle," surrounded by thick, hyaline eosinophilic material. Peripheral palisading and ductal lumen formation are present.

2. **Syringoma (Fig 2.2)**

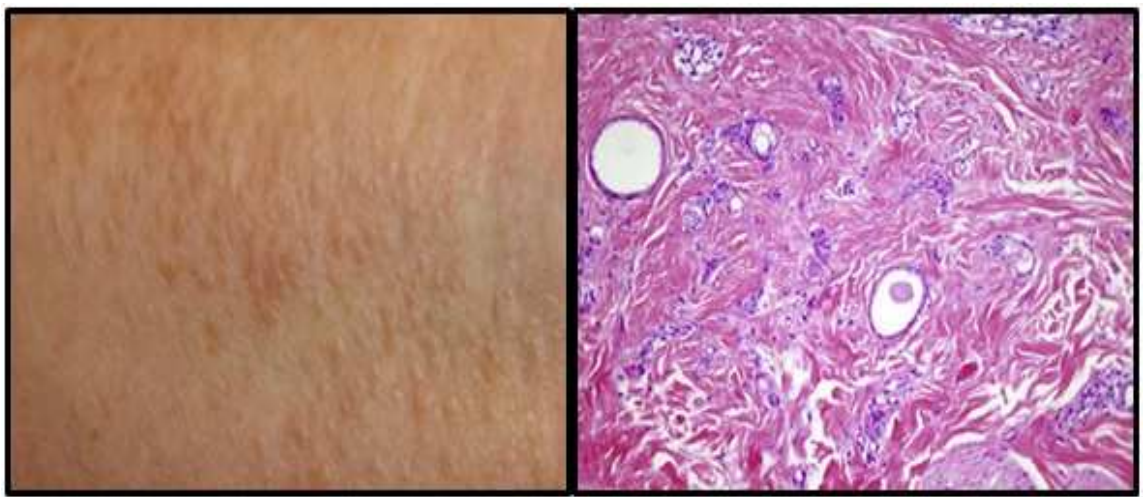


Fig 2.2 - Syringoma

Fig 2D - Gross -Small, firm, flesh-colored to yellowish papules, typically 1–4 mm in diameter.

Fig 2E H&E (40x) - Comprised of multiple small ducts and solid nests of basaloid epithelial cells embedded in a fibrous stroma. The ducts are lined by two layers of cuboidal cells. Characteristic comma- or tadpole-shaped ducts ("paisley-tie" pattern) seen.

3. **Hidradenoma papilliferum (Fig 2.3)**

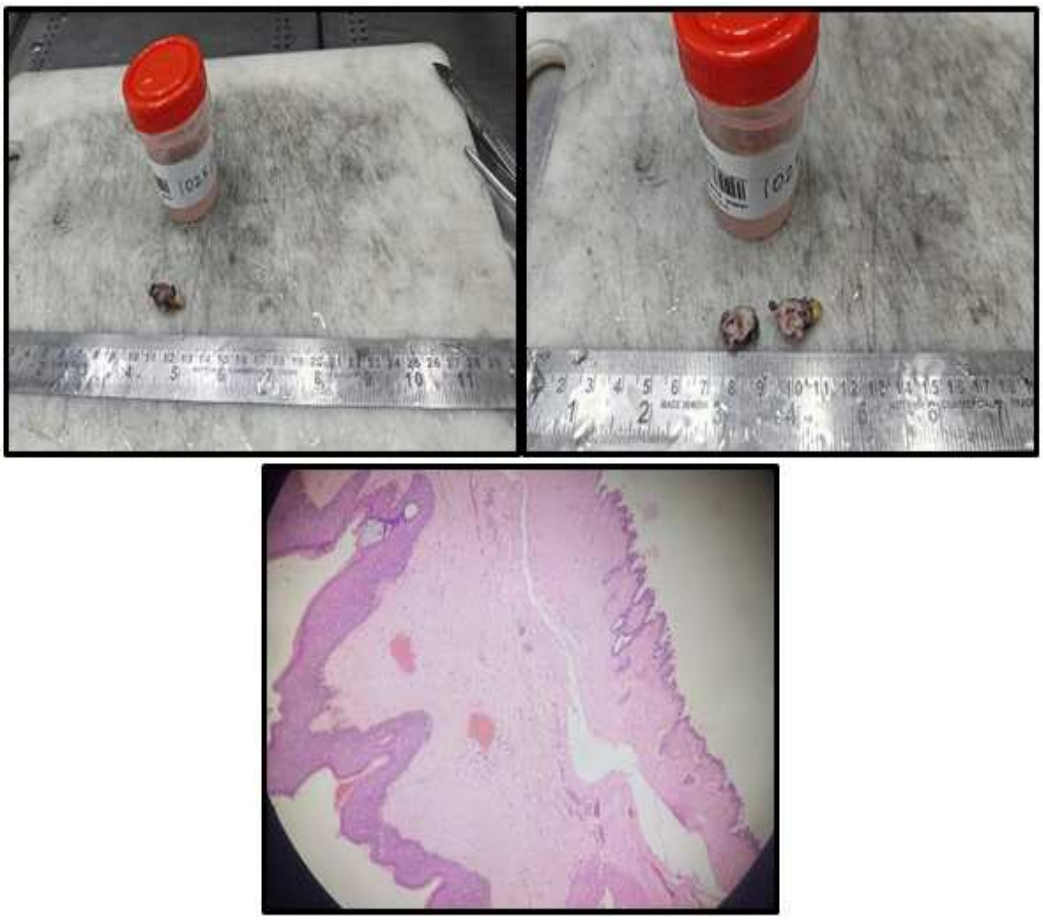


Fig 2.3 - Hidradenoma Papilliferum

Fig 2.3A & 2.3B - Gross - Well-circumscribed, reddish nodules measuring 2 cm,

Fig 2.3C H&E (10x) - Shows cystic and papillary structures lined by a single to double layer of columnar cells exhibiting apocrine decapitation secretion.

4. Hidrocystoma (Fig 2.4)

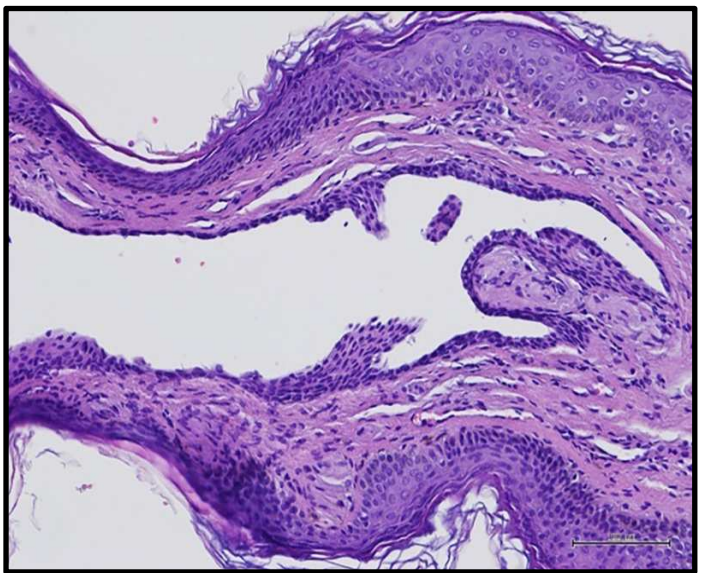


Fig 2.4 Hidrocystoma

Fig 2.4A H&E (10x) - Section shows well circumscribed cystic lesion lined by two layers of cuboidal epithelium without atypia. The lumen of cyst is empty.

5. Syringocystadenoma papilliferum (Fig 2.5)

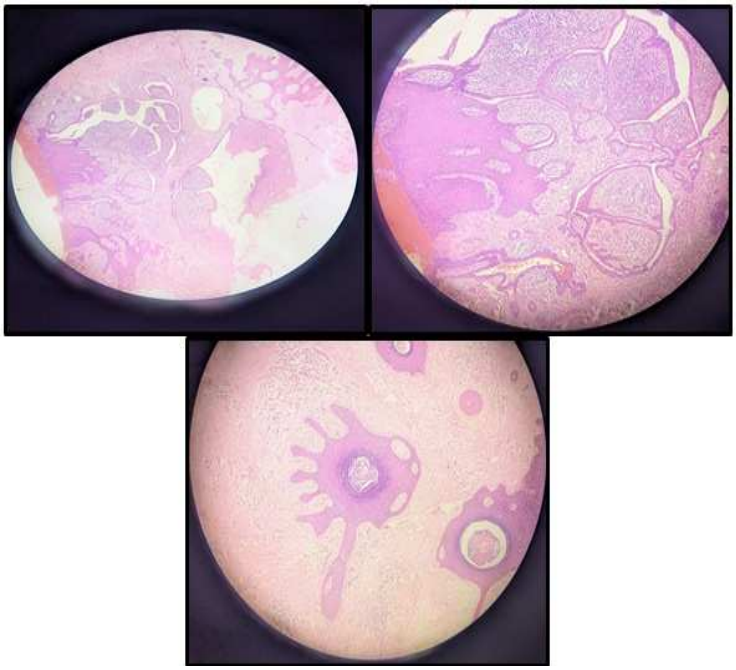


Fig 2.5. Syringocystadenoma Papilliferum

Fig 2.5A H&E (10x) - Cystic invaginations from epidermis.

Fig 2.5B H&E (40x)Fig 2.5C H&E (40x)-Cystic invaginations from epidermis with papillary projections lined by two layers of epithelium with dense plasma cell infiltrate in stroma.

6. Chondroid syringoma (Fig 2.6)

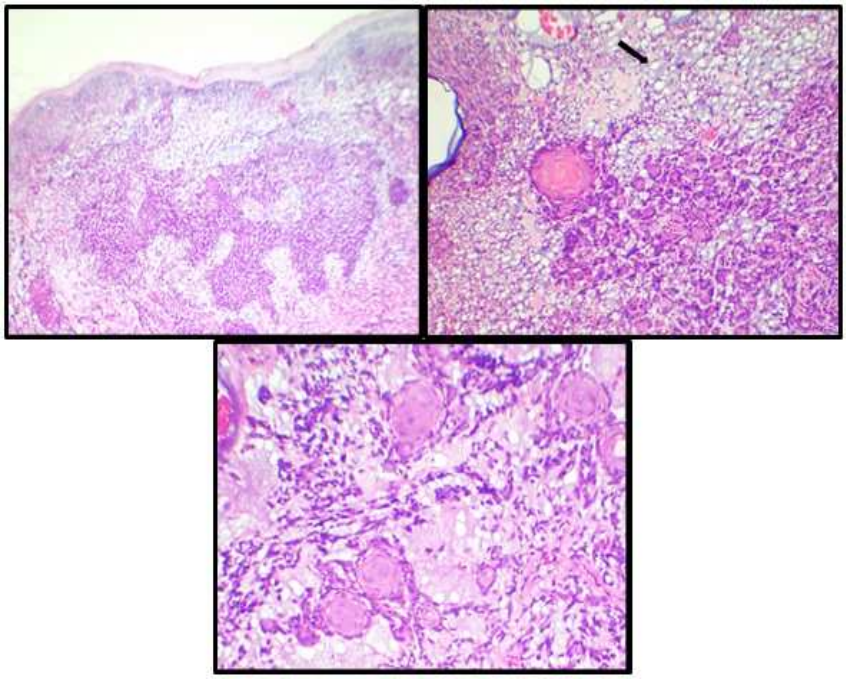


Fig 2.6. Chondroid Syringoma

Fig 2.6A H&E (4x)- Well-circumscribed lobulated tumor.

Fig 2.6B H&E (10x)Fig 2.6C H&E (40x)-Tumor with epithelial (ductal, tubular) and myoepithelial components in a chondromyxoid stroma, with occasional keratin cysts.

7. Nodular hidradenoma (Fig 2.7)

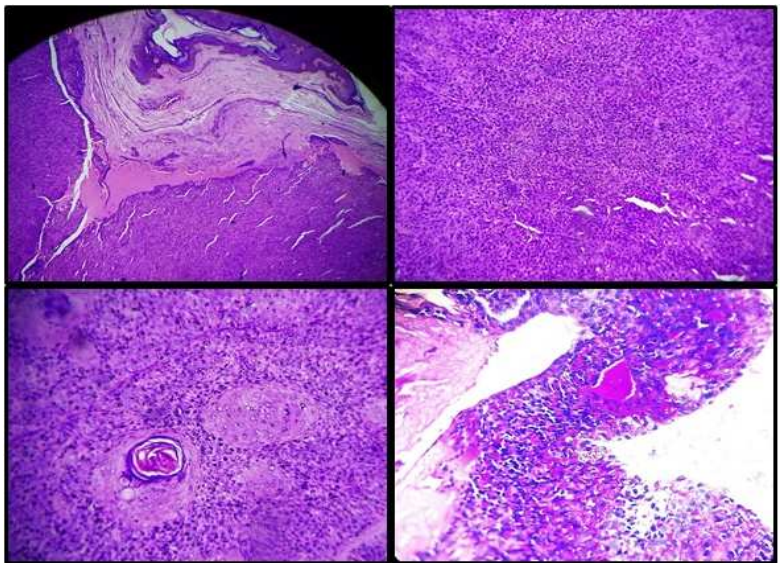


Fig 2.7 Nodular Hidradenoma

Fig 2.7A H&E (4x) - Cellular tumor with solid and cystic areas.

Fig 2.7B H&E (10x)- Tumor composed of polygonal to clear cells arranged in sheets, nests, or cords,

Fig 2.7C H&E (40x)Fig 2.7D H&E (40x)-Cellular tumor with solid and cystic areas composed of polygonal to clear cells, with duct-like structures and low mitotic activity.

8. Spiradenoma (Fig 2.8)

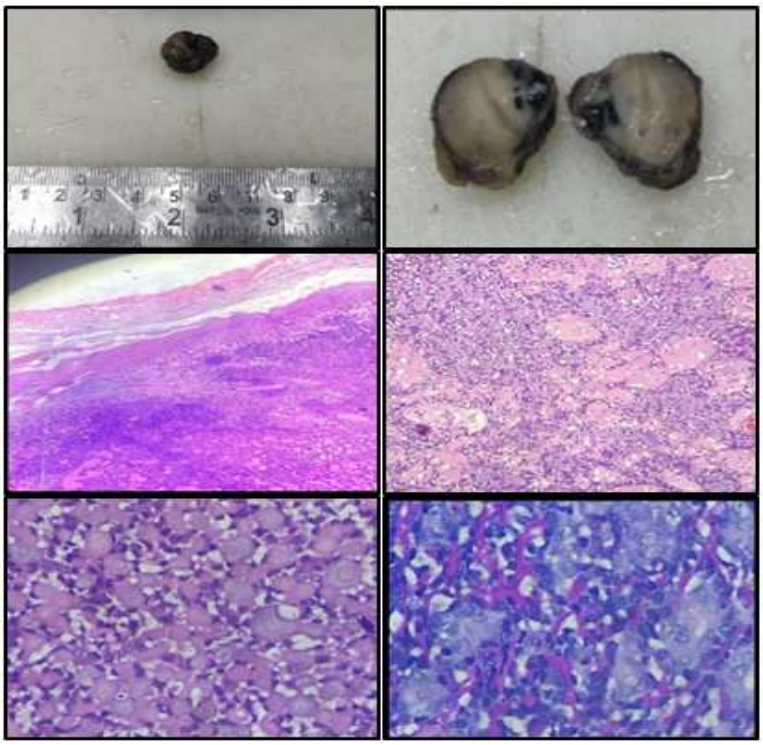


Fig 2.8. Spiradenoma

Fig 2.8A &Fig 2.8B- solitary, skin-colored nodule.

Fig 2.8C H&E (4x)Fig 2.8D H&E (10x)- Well-circumscribed lobules composed of small basaloid cells with peripheral darker nuclei and lighter central cells.

Fig 2.8E H&E (10x)Fig 2.8F PAS (40x)- small basaloid cells with peripheral darker nuclei and lighter central cells, arranged in cords, with prominent vascular stroma.

3. Sebaceous Tumors

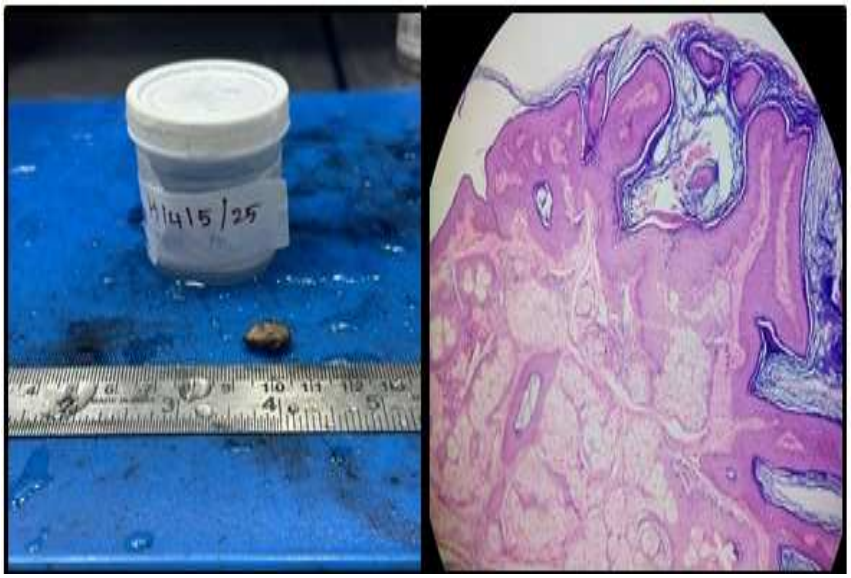


Fig 3.1 Nevus Sebaceous

Fig 3.1A -Gross: Yellowish verrucous plaque, excised from scalp .

Fig 3.1B H&E (10x)-Sebaceous gland hyperplasia with epidermal papillomatosis, immature hair follicles.

3.2 Sebaceoma

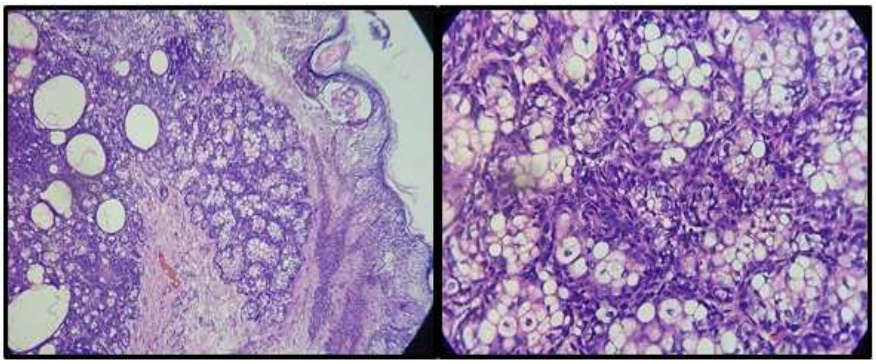


Fig 3.2 Sebaceoma

Fig 3.2A H&E (10x) Fig 3.2B H&E (40x)- Lobules of basaloid cells with intermixed mature sebaceous cells showing vacuolated cytoplasm. Malignant features include focal necrosis and nuclear pleomorphism.

4. Rare and Mixed Tumors

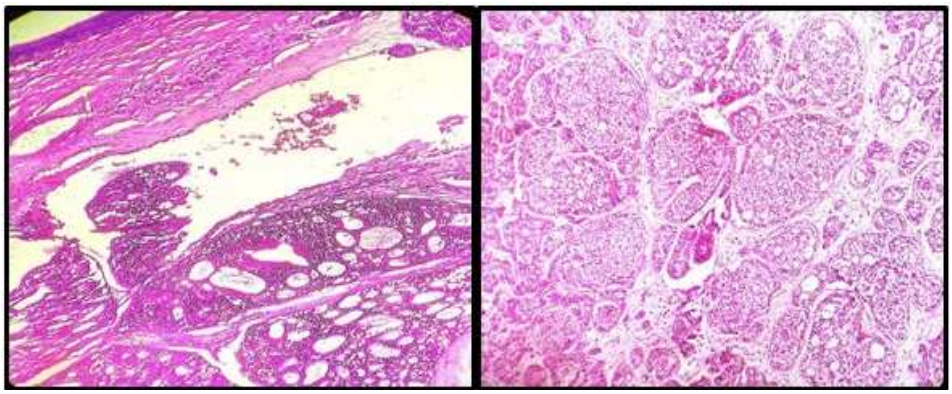


Fig 4.1 Adenoid Cystic Carcinoma (Primary Cutaneous)

Fig 4.1A H&E (10x) Fig 4.1B H&E (40x)-Infiltrative cords and tubules of basaloid cells arranged in cribriform "Swiss cheese" pattern with cytologic atypia.

4.2 Eccrine mucinous carcinoma



Fig 4.2 Eccrine Mucinous Carcinoma

Fig 4.2A (Gross)- Soft, painless, skin-colored to bluish nodule .

Fig 4.2B H&E (10x) &Fig 4.2C H&E (10x)- Histopathology revealed epithelial clusters and cribriform arrangements within mucinous lakes. Nuclear enlargement and variable atypia noted.

DISCUSSION

In this group, adnexal neoplasms showed a diverse group of tumors derived from the adnexal structures of the skin, mainly hair follicles, sebaceous glands, eccrine and apocrine sweat glands. Clinically diagnosing these tumors is difficult due to their similar and unclear presentations, rarity, and varied evaluation. Consequently, accurate diagnosis depends heavily on thorough histopathological evaluation, often supported by additional methods like immunohistochemistry (IHC). This study examines the clinicopathological profile of 42 confirmed SAT cases, looking at their morphological range, anatomical distribution, and clinicopathological relation, while comparing results with existing literature.

Parameter	Samaila et al.	Radhika et al.	Saha et al.	Sharma et al.	Rajalakshmi et al.	El Ochi et al.	Nair	Present Study
Study period	Jan 1991–Dec 2006	Jan 1993–Dec 2003	Jun 2007–May 2008	Jun 2004–Jun 2010	2009–2013	Jan 2009–Dec 2014	3 years	Jan 2023–Dec 2025
Total cases	52	35	23	56	21	96	33	42
Most common age group affected	33 yrs	20–30	29.19±11.68	51–60	30–40	31–40	11–20	20–39
Male:Female	1:1	0.7:1	1.1:1.9	1.07:1	1.1:1	1.7:1	1.2:3	1:1.47
Most common site	Head & neck	Head & neck	-	Head & neck	Head & neck	Head & neck	Head & neck	Head & neck
Benign tumors (%)	88.5	77.14	100	80.36	90.48	97.7	100	92.86
Malignant tumors (%)	11.5	29.63	-	19.64	9.52	2.3	-	7.14
Most common benign tumor	Eccrine acrospiroma(32.7%)	Nodular hidradenoma; nevus sebaceous (14.2% each)	Syringoma (39.13%)	Clear cell hidradenoma ;pilomatricoma (21.43%)	Pilomatricoma (19.04%)	Pilomatricoma (33.3%)	Syringoma (42.42%)	Pilomatricoma (35.71%)
Most common malignant tumor	Sweat gland carcinoma(11.5%)	Sweat gland carcinoma(11.4%)	-	Sebaceous carcinoma(19.64%)	Aggressive digital papillary, adenocarcinoma; malignant, dermal eccrine cylindroma	Porocarcinoma; eccrine sweat carcinoma, (one case each)	-	Sweat gland carcinoma (4.76%)

Pilomatricoma was the most common benign tumor (35.71%) and was characterized histologically by the typical follicular matrix differentiation pattern. This pattern includes peripheral basaloid cells surrounding central keratinized or shadow cell zones. Features like dystrophic calcification and a surrounding giant cell reaction are common. The presence of both basaloid cells and central shadow cells in pilomatricoma is typically localized to the scalp, trunk, and extremities. The high occurrence of pilomatricoma and trichilemmal cysts aligns with those reported in the studies mentioned earlier, confirming their status as common benign follicular skin adnexal tumors.

Sweat gland tumors in our series includes benign types such as syringoma, hidradenoma, and hidrocystoma, along with the less common malignant eccrine mucinous carcinoma, Primary Cutaneous Adenoid Cystic Carcinoma and High-grade Malignant Trichilemmal Tumor. These tumors primarily affects the head, neck, and facial areas, which is consistent with literature that emphasizes sweat gland tumors' preference for areas rich in pilosebaceous structures. The incidence of sweat gland tumors (47.62%) aligns with recent studies and larger group studies, underlining their clinical importance.

Sebaceous tumors made up a smaller yet significant group, with benign types like sebaceous adenoma and nevus sebaceous, while sweat gland carcinoma was the main malignant subtype. The malignancy profile matches the findings of Kaur et al. and other published studies that identify sweat gland carcinoma as the leading malignant SAT, especially in periocular locations known for aggressive behavior.

Benign vs. Malignant Patterns

A notable aspect of our study was the significant dominance of benign SATs (92.86%), with malignancies making up a small percentage (7.14%). This small group included adenoid cystic carcinoma, eccrine mucinous carcinoma, and a high-grade malignant trichilemmal tumor. This distribution closely aligns with Bhale & Shah's results (94% benign), Sejekan & Biligi (94.3%), and Kaur et al. (82.7%), all confirming the rarity of malignant SATs.

Benign lesions displayed organized patterns and uniformity in cell architecture. In contrast, malignant lesions exhibited features such as irregular architecture, invasive growth, necrosis, mitosis and pleomorphism.

Demographic and Site Distribution

Our data support a strong tendency for SATs to appear in the head, neck, and facial regions, places rich in pilosebaceous and eccrine units, making up over 60% of tumors. This finding aligns with regional and global literature, including studies by Bhale & Shah, Sejekan & Biligi, and Kandasamy et al., highlighting the importance of these anatomical areas in the growth of adnexal tumors.

The age distribution was primarily between the third and sixth decades of life, similar to demographics in comparative studies. We noted a slight female predominance, consistent with reports suggesting possible hormonal influences and differences in health-seeking behavior. These demographic trends emphasize the need for increased diagnostic awareness among middle-aged adults who present with adnexal lesions in these typical areas.

Comparison with Prior Studies

Our observations confirm well-known epidemiological trends: follicular and sweat gland tumors are the most common in the SAT classification. Although the malignant SAT subset is rare, it is crucial due to its aggressive behavior, frequent local recurrence, and potential for spreading.Primary cutaneous adenoid cystic carcinoma, eccrine mucinous carcinoma and high-grade malignant trichilemmal tumor are the more common malignant tumors, while rarer follicular and apocrine carcinomas have also been documented.
Benign lesions like pilomatricoma and trichilemmal cysts create diagnostic challenges because they can look similar to malignant tumors. Therefore, comprehensive histopathological assessment, along with architectural analysis and specific IHC panels, is recommended by Lever's Histopathology and WHO classification systems for accurate tumor categorization.

Parameter	Finding in present study
Most common age group affected	20–39 years (25 of 42 cases; 52.38%)
Most common anatomical site	Head & neck region (27 of 42 tumors; 64.3%)
Most common tumor type overall	Pilomatricoma (14 of 42 tumors; 35.71%)
Most common benign tumor	Pilomatricoma (follicular differentiation)
Most common malignant tumors	Primary cutaneous adenoid cystic carcinoma, eccrine mucinous carcinoma, high-grade malignant trichilemmal tumor (one case each)
Predominant pattern	Young adults (20–39 yrs) with head & neck pilomatricoma as the typical presentation.

CLINICOPATHOLOGICAL RELEVANCE

The detailed clinicopathological documentation and systematic tumor subtyping underline important implications for prognosis and treatment planning. Benign SATs, which can be treated with local excision, usually have excellent outcomes. In contrast, malignant variants require aggressive surgical management and ongoing monitoring to reduce risks related to illness and death. This study supports findings by Sejekan et al., Kaur et al., and others that timely and accurate histopathological diagnosis enables tailored management plans.

Moreover, awareness of syndromic associations, such as Cowden syndrome with multiple trichilemmomas and Muir-Torre syndrome with sebaceous tumors, highlights the crucial role of histopathology in identifying possible internal cancers. This requires pathologists and clinicians to stay alert for syndromic contexts and involve multidisciplinary evaluations when needed.

CONCLUSION

The experiences shared in this study and related literature show that skin adnexal tumors consist of a wide range of neoplasms mainly derived from hair follicles, sebaceous glands, and sweat glands, with most being benign. Due to their similar clinical symptoms, histopathological examination is still the key diagnostic method. Most SATs occur in the head and neck regions of middle-aged individuals, with slight differences between genders. Pilomatricomas are the most commonly found benign tumors, while Primary cutaneous adenoid cystic carcinoma, eccrine mucinous carcinoma, high-grade malignant trichilemmal tumor are the leading malignant form. Malignant SATs, although rare, must be identified quickly because of their potential for invasion and metastasis. Diagnostic accuracy improves through careful architectural assessment combined with immunohistochemical studies in tough cases.

Comprehensive pathological evaluations inform clinical decisions and enhance patient outcomes. Benign tumors generally respond well to complete surgical removal, while malignant types need more aggressive management and closer follow-up. A combined approach that includes clinicopathological correlation and awareness of tumor syndromes improves early detection and effective treatment, underscoring the essential role of the pathologist in the multidisciplinary care of patients with skin adnexal tumors.

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