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Histopathological Profile of Eyelid Lesions Over a Decade: A Retrospective Study from a Tertiary Care Centre

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ABSTRACT

Introduction: Eyelid lesions present in a wide variety, from harmless swellings to aggressive cancers. They can affect vision, appearance, and quality of life. Histopathology plays a key role in differentiating these and guiding treatment.
Aim: To study the histopathological patterns of eyelid lesions seen over ten years in our centre, and to look at their age, gender, and site distribution.
Methods: We reviewed 1137 eyelid biopsy specimens reported in the Pathology Department, Sarojini Devi Eye Hospital, Hyderabad, between 2014 and 2024. For each case, we noted the patient's age, gender, site of lesion, and final histopathological diagnosis. The data were analysed to look for trends and patterns.
Results: Of the 1137 cases, 576 were females and 561 males. Patients ranged from 1 to 90 years, with most in their 40s to 60s. Non - neoplastic lesions made up 30.5%, most commonly pyogenic granuloma (7.5%). Neoplasms accounted for 69.5%, with benign tumours far outnumbering malignant ones (58.7% vs 10.8%). Among benign lesions, intradermal nevus was the most frequent (15.3%). Meibomian gland carcinoma was the leading malignant tumour (7.6%). The upper eyelid was more often affected in both benign (61.8%) and malignant (58.5%) cases.
Conclusion: In our experience, benign eyelid lesions are more common, but malignancies are still significant, especially in older patients. Histopathology remains the gold standard for diagnosis. A low threshold for biopsy particularly in high-risk groups can help catch cancers early and improve outcomes.

Keywords: *Eyelid lesions, Histopathology, Retrospective Study, Tertiary Care Centre, Clinicopathological correlation.*

INTRODUCTION

The eyelids, comprising complex anatomical structures including skin, muscle, glands, and specialized tissues, serve as essential protective barriers for the ocular surface while contributing significantly to facial aesthetics. The rich histological diversity of eyelid tissues predisposes to a wide spectrum of pathological conditions, ranging from non – neoplastic processes to benign proliferations and malignant neoplasms [1]. These lesions carry considerable clinical significance, potentially affecting visual function, ocular comfort, and cosmetic appearance.

Eyelid pathology demonstrates remarkable geographical and ethnic variation, with distinct patterns observed across different populations worldwide. While Western literature predominantly reports basal cell carcinoma as the most common eyelid malignancy, Asian populations show a distinctly different distribution, with sebaceous gland carcinomas assuming greater prominence [2,3]. These variations reflect complex interactions between genetic predisposition, environmental factors, and cultural practices that influence disease susceptibility and presentation patterns.

The accurate diagnosis of eyelid lesions presents unique challenges to clinicians and pathologists alike. Many malignant conditions, particularly sebaceous gland carcinomas, exhibit remarkable ability to masquerade as benign inflammatory conditions such as chalazion or chronic blepharoconjunctivitis, leading to significant diagnostic delays and potentially

devastating consequences [4]. The morphological heterogeneity of eyelid lesions, combined with overlapping clinical presentations, underscores the critical importance of histopathological examination for definitive diagnosis.

Contemporary diagnostic approaches increasingly rely on immunohistochemical techniques to enhance diagnostic accuracy, particularly in morphologically challenging cases. Markers such as p40 for squamous differentiation, adipophilin for sebaceous differentiation, and Ber-EP4 for basal cell carcinoma have revolutionized the diagnostic landscape, providing pathologists with powerful tools to achieve definitive diagnoses even in poorly preserved or morphologically ambiguous specimens [5,6].

The epidemiological understanding of eyelid lesions within specific populations remains incomplete, particularly in developing countries where comprehensive long-term studies are limited. Regional variations in disease patterns, age-specific distributions, and gender predilections require systematic investigation to inform clinical practice and guide healthcare resource allocation. Such knowledge is essential for developing appropriate screening protocols, treatment guidelines, and prognostic assessments tailored to specific populations.

Aims and Objectives

This study aims to comprehensively analyze the histopathological spectrum of eyelid lesions diagnosed over a decade at a tertiary care center, with specific objectives to:

1. Determine the frequency and distribution of various eyelid lesions in the study population
2. Analyze demographic characteristics including age, gender, and anatomical site predilection
3. Correlate clinical presentations with histopathological findings
4. Evaluate the utility of immunohistochemical markers in challenging diagnostic cases
5. Compare findings with national and international literature to identify regional variations
6. Assess the role of advanced diagnostic techniques in improving diagnostic accuracy

MATERIALS AND METHODS

Study Design and Setting

This retrospective observational study was conducted at the Department of Pathology, Sarojini Devi Eye Hospital, Hyderabad, examining all eyelid biopsies received over a 10-year period from January 2014 to December 2024. The hospital serves as a major tertiary referral center for ophthalmic conditions in South India, providing comprehensive eye care services to a diverse patient population.

Inclusion and Exclusion Criteria

All histopathologically confirmed eyelid lesions with complete demographic and clinical data were included in the study. Cases with inadequate tissue samples, missing clinical information, or uncertain anatomical origin were excluded from analysis. Repeat biopsies from the same patient were counted as separate entities only if they represented distinct lesions or recurrences after a disease-free interval.

Data Collection and Variables

Comprehensive data extraction was performed from histopathology registers, pathology reports, and electronic medical records. Variables collected included patient demographics (age, gender), clinical presentation details, anatomical location (upper eyelid, lower eyelid, medial canthus, lateral canthus), lesion characteristics and histopathological diagnosis.

Histopathological Examination

All specimens were processed using standard histopathological techniques. Tissues were fixed in 10% neutral buffered formalin, processed through graded alcohols, embedded in paraffin, and sectioned at 4-5 microns thickness. Routine staining was performed using hematoxylin and eosin (H&E) technique. Special stains and immunohistochemical markers were employed when clinically indicated or morphologically required.

Immunohistochemical Analysis

Immunohistochemical staining was performed using standard protocols for challenging diagnostic cases. The panel included:

- **p40**: A highly sensitive and specific marker for squamous cell carcinoma, particularly valuable in poorly differentiated cases where morphological features alone were insufficient for diagnosis
- **Adipophilin**: Essential for confirming sebaceous gland differentiation in suspected sebaceous gland carcinomas, demonstrating characteristic cytoplasmic lipid droplet staining patterns
- **Ber-EP4**: Utilized for basal cell carcinoma confirmation, showing strong membranous and cytoplasmic positivity in basal cell carcinoma while remaining negative in other epithelial tumors

Statistical Analysis

Statistical analysis was performed using appropriate software packages. Descriptive statistics including frequencies, percentages, means, and standard deviations were calculated for categorical and continuous variables respectively. Cross-tabulations were performed to analyze relationships between demographic variables and lesion types. Chi-square tests were employed to assess statistical significance of associations, with p-values <0.05 considered statistically significant.

RESULTS

Demographic Characteristics

The study comprised 1,137 eyelid lesion cases with a slight female predominance of 627 patients (55.1%) compared to 510 males (44.7%), yielding a male-to-female ratio of 1:1.23. Patient ages ranged from 1.5 to 90 years, with a mean age of 39.7 years (standard deviation: 19.8 years). The distribution across age decades revealed the highest frequency in the 55-64 year group (181 cases, 15.91%), followed closely by the 37-46 year group (173 cases, 15.21%) and 28 to 37 year group (171 cases, 15.03%).

Anatomical Distribution

Upper eyelid involvement predominated with 672 cases (59.10%), followed by lower eyelid lesions in 457 cases (40.19%). Additional sites included 7 cases (0.61%) involving the medial canthi, lacrimal gland and margin. Right and left eye involvement showed relatively equal distribution with 591 (51.97%) and 546 (48.02%) cases respectively.

Figure 1 - Gender Distribution of Lesions

Gender and Site	Benign	Malignant	Non -Neoplastic	Grand Total
Female	**286**	**112**	**229**	**627**
lacrimal gland		1	1	2
lower eyelid	122	42	96	260
margin			1	1
medial canthus	1			1
upper eyelid	163	69	131	363
Male	**181**	**66**	**263**	**510**
angular dermoid			1	1
lacrimal gland		1	1	2
lower eyelid	81	22	94	197
upper eyelid	100	43	167	309
Grand Total	**467**	**178**	**492**	**1137**

Histopathological Classification

The comprehensive analysis revealed 492 non-neoplastic conditions (43%), 467 benign lesions (41%) and 178 malignant neoplasms (16%). This distribution demonstrates the predominantly benign nature of eyelid pathology while highlighting the significant clinical burden of malignant diseases.

Benign Lesions Analysis

Among benign lesions, intradermal nevus emerged as the most common diagnosis with 143 cases (12.58% of all lesions), followed by capillary hemangioma with 74 cases (6.5%). Other frequently encountered benign conditions included squamous papilloma (62 cases, 5.45%), compound nevus (56 cases, 4.93%), hidrocystoma (25 cases, 2.19%). Vascular lesions, predominantly capillary hemangiomas, showed age-related distribution patterns with higher prevalence in younger age groups, consistent with their developmental nature. The diversity of benign lesions reflects the complex histological composition of eyelid tissues and their varied proliferative responses.

S.No	Benign	Total (467)
1.	Intradermal nevus	143(12.58%)
2.	Capillary Hemangioma	74(6.5%)
3.	Squamous papilloma	62(5.45%)
4.	Compound nevus	56(4.93%)
5.	Hidrocystoma	25(2.19%)
6.	Verruca vulgaris	16(1.41%)
7.	Cavernous hemangioma	16(1.41%)
8.	Sebaceous adenoma	10(0.88%)
9.	Neurofibroma	10(0.88%)

Malignant Neoplasms Profile

Malignant lesions demonstrated a striking pattern with meibomian gland carcinoma (sebaceous gland carcinoma) predominating at 102 cases (8.97%). This was followed by basal cell carcinoma with 36 cases (3.17%),squamous cell

carcinoma with 15 cases (1.32%) and Non-Hodgkin lymphoma with 11 cases (0.96%) and miscellaneous rare malignancies.

The age distribution of malignant lesions revealed a clear predilection for older age groups. The mean age for malignant lesions was 58.2 years which is significantly higher than the overall study population mean.

S.No	Malignant Diagnosis	Total(178)
1.	Meibomian Gland Carcinoma	102 (8.97%)
2.	Basal Cell Carcinoma	36 (3.17%)
3.	SCC	15 (1.32%)
4.	NHL	11(0.96%)

Non-neoplastic Conditions

Non-neoplastic conditions comprised 492 cases (43%) with epidermoid cyst being the most common (125 cases,10.99%). Other frequently occurring conditions include dermoid cyst (85 cases, 7.48%), pyogenic granuloma (81 cases, 7.12%), and keratinous cyst (21 cases,1.85%).

S.No.	Non - Neoplastic	Total (492)
1.	Epidermoid cyst	125(10.99%)
2.	Dermoid cyst	85(7.48%)
3.	Pyogenic granuloma	81(7.12%)
4.	Keratinous cyst	21(1.85%)
5.	Molluscum contagiosum	20(1.76%)
6.	Chalazion	12(1.06%)
7.	Ductal cyst	10(0.88%)

S.No	Diagnosis	Cases (%)	Male (n%)	Female (n%)	Upper Lid (n%)	Lower Lid (n%)
Non-Neoplastic Lesions						
1	Epidermoid Cyst	125 (10.99%)	77 (6.77%)	48 (4.22%)	77 (6.77%)	48 (4.22%)
2	Dermoid Cyst	85 (7.47%)	43 (3.78%)	42 (3.69%)	60 (5.27%)	25 (2.19%)
3	Pyogenic Granuloma	81 (7.12%)	46 (4.04%)	35 (3.07%)	52 (4.57%)	29 (2.55%)
4	Keratinous Cyst	21 (1.84%)	11 (0.96%)	10 (0.87%)	12 (1.05%)	9 (0.79%)
5	Molluscum Contagiosum	20 (1.75%)	11 (0.96%)	9 (0.79%)	12 (1.05%)	8 (0.70%)
6	Chalazion	12 (1.05%)	9 (0.79%)	3 (0.26%)	8 (0.70%)	4 (0.35%)
7	Ductal Cyst	10 (0.87%)	5 (0.43%)	5 (0.43%)	7 (0.61%)	3 (0.26%)
Benign Lesions						
1	Intradermal Nevus	143 (12.57%)	23 (2.02%)	120 (10.55%)	72 (6.33%)	71 (6.24%)
2	Capillary Hemangioma	74 (6.50%)	40 (3.51%)	34 (2.99%)	50 (4.39%)	24 (2.11%)
3	Squamous papilloma	62 (5.45%)	39 (3.43%)	23 (2.02%)	38 (3.34%)	24 (2.11%)
4	Compound nevus	56 (4.92%)	11 (0.96%)	45 (3.95%)	29 (2.55%)	27 (2.37%)
5	Hidrocystoma	25 (2.19%)	14 (1.23%)	11 (0.96%)	14 (1.23%)	11 (0.96%)
6	Verruca vulgaris	16 (1.40%)	9 (0.79%)	7 (0.61%)	10 (0.87%)	6((0.52%)
7	Cavernous Hemangioma	16 (1.40%)	5 (0.43%)	11 (0.96%)	7 (0.61%)	9 (0.79%)

8	Sebaceous adenoma	10 (0.87%)	7 (0.61%)	3 (0.26%)	5 (0.43%)	5 (0.43%)
9	Neurofibroma	10 (0.87%)	6 (0.52%)	4 (0.35%)	9 (0.79%)	1((0.08%)
Malignant Lesions						
1	Meibomian Gland Carcinoma	102 (8.97%)	37 (3.25%)	65 (5.71%)	74 (6.50%)	28 (2.46%)
2	Basal Cell Carcinoma	36 (3.16%)	10 (0.87%)	26 (2.28%)	12 (1.05%)	24 (2.11%)
3	Squamous Cell Carcinoma	15((1.31%)	8 (0.70%)	7 (0.61%)	9 (0.79%)	6 (0.52%)
4	Non-Hodgkin Lymphoma(NHL)	11 (0.96%)	6 (0.52%)	5 (0.43%)	9 (0.79%)	2 (0.17%)

Age-specific Distribution Patterns

Analysis of age-specific distribution revealed distinct patterns for different lesion categories. Benign lesions showed a broad age distribution with peaks in the third and fourth decades, while malignant lesions demonstrated clear predilection for older age groups. Congenital and developmental lesions, including dermoid cysts and vascular malformations, predictably showed higher prevalence in pediatric and young adult populations. Inflammatory conditions demonstrated bimodal distribution with peaks in younger and older age groups, reflecting different pathogenetic mechanisms across age groups.

Gender-specific Patterns

Gender analysis revealed interesting patterns across different lesion types. While the overall female predominance was modest (55.1%), certain lesions showed more pronounced gender predilections. Meibomian gland carcinoma demonstrated female predominance (63.7% females vs 36.2% males), consistent with international literature. Basal cell carcinoma also showed female predominance (72.2% females vs 27.7% males), while squamous cell carcinoma demonstrated equal gender distribution.

Benign lesions showed varied gender distributions, with nevoid lesions showing female predominance (75.4%) and cystic lesions showing relatively equal distribution between genders. These patterns may reflect hormonal influences, occupational exposures, or genetic predispositions specific to different lesion types.

Discussion

This comprehensive retrospective study by Nair et al. provides valuable insights into the variety and frequency of eyelid lesions over a decade (2014–2024) at a tertiary care center in South India, analyzing 1,137 cases. This large dataset allows meaningful comparisons with other regional and international studies, highlighting similarities, differences, and regional variations in the epidemiology and histopathological spectrum of eyelid lesions.

Comparison with Chaudhury et al. (Assam)

Chaudhury et al. examined 105 eyelid lesions over five years, reporting a notably higher proportion of non-neoplastic lesions at 89% (94 cases), with chalazion being the most common lesion at 19% (20 cases), and epidermal cyst also prominently observed. The malignant lesion proportion was 11% (11 cases), with sebaceous carcinoma accounting for 36% (4 cases) of the malignant group. In comparison, the present study reported 47% (533 cases) non-neoplastic lesions with epidermal cysts constituting 14% (159 cases), and malignant lesions comprising 15% (171 cases), with sebaceous carcinoma encompassing 48% (82 cases) of malignancies. The elevated non-neoplastic lesions in Assam may reflect differing referral patterns or environmental factors influencing lesion prevalence.

Comparison with Mohan et al. (Kerala)

The Kerala study by Mohan et al. involved 414 patients over ten years, where non-neoplastic lesions accounted for 29% (120 cases), significantly less than the present study's 47% prevalence. They reported epidermal cysts as the leading non-neoplastic lesion at 10% (40 cases), aligning with findings in the current study. Benign tumors formed 38% (157 cases), led by nevus and its subtypes, consistent with the present study's 37% benign prevalence and predominance of intradermal nevus at 15% (170 cases). Malignant lesions were more frequent at 33% (138 cases), with sebaceous carcinoma again the most common malignant entity at 24% (33 cases), reinforcing its significance within South Indian populations.

Comparison with Sonagara et al. (Ahmedabad)

Sonagara et al. analyzed 205 eyelid lesions within one year, noting a high malignant lesion proportion of 37% (75 cases)—more than double that of the current study. Notably, squamous cell carcinoma (SCC) was the most frequent malignancy, at 13.5% (28 cases), exceeding the frequency of sebaceous carcinoma, a distinct divergence from the rest of South Indian data. Non-neoplastic lesions composed 47% (96 cases) of the dataset, with dermoid cysts as the predominant non-neoplastic

lesion. Benign tumors were comparatively low at 16% (33 cases). This unique prevalence of SCC may stem from regional UV exposure, genetic factors, or diagnostic biases, highlighting intra-national heterogeneity.

Comparison with Anandini et.al. (Ahmedabad)
Anandini et.al. analyzed 230 cases over 6 years with the highest incidence of cases in the 3rd decade (17.39%) [15]. There was a Male predominance found in this study (57.82%) with malignant lesions occurring mainly after 60 years of age. Overall Benign lesions were more common than malignant with Nevus (12.17%) being the most common benign lesion. Like in Sonagara's et.al. study, there was prevalence of SCC (10.43%) as the most frequently occurring Malignant lesion. This study's epidemiology and lesional break up was similar to the other study from the same region.

Comparison with Chakrabarti et al. (Bhavnagar)
Data from Chakrabarti et al. involved 50 patients over 2.5 years, with a non-neoplastic lesion frequency of 56% (28 cases) and benign tumors accounting for 20% (10 cases). Malignant tumors formed 24% (12 cases), a higher malignancy burden relative to many regional studies. Their most common malignant tumor was basal cell carcinoma (BCC), contrasting with the sebaceous carcinoma predominance observed in the current study and other South Indian centers. This difference underscores notable geographic and possibly environmental or referral-related variation within India.

Comparison with Mary et al. (Hong Kong)
Mary et al.'s study of 198 eyelid lesions recorded 40% non-neoplastic and 32% benign lesions; however, precise lesion-specific percentages were not detailed. The existence of sebaceous carcinoma as a prominent malignant tumor aligns with trends seen in the Indian subcontinent.

Comparison with Kaliki et al. (India)
Kaliki et al. reported on 536 eyelid tumors, exhibiting a higher benign lesion proportion of 53% (285 cases) compared to the present study's 37%. Non-neoplastic lesions comprised 39% (209 cases), while malignancies were lower at 8% (42 cases). Sebaceous carcinoma dominated the malignant category at 40%, reinforcing its regional significance.

Comparison with Huang et al. (China)
In a large series of 2,228 histologically confirmed eyelid tumors, Huang et al. documented 53% non-neoplastic and 42% benign lesions. Malignancies constituted 15% of cases, paralleling the current study. However, their malignant tumor profile showed BCC predominance at 15%, contrasting with the sebaceous carcinoma dominance documented in South India. This suggests geographical and ethnic variability in tumor biology and UV exposure effects.

Comparison with Deprez et al. (Switzerland)
Deprez et al.'s European study reviewed over 5,000 eyelid tumors, highlighting BCC as the overwhelmingly predominant malignant tumor, occupying up to 80-90% of such tumors—a stark contrast with Asian data where sebaceous carcinoma leads . This discrepancy accentuates racial and environmental differences impacting tumor prevalence and behavior.

Epidemiological and Clinical Implications
Age distribution across studies consistently places non-neoplastic and benign lesions within the 20 - 59 year range, while malignant lesions predominantly affect individuals aged ≥60 years, echoing a longstanding age-associated risk profile for malignant transformation. The current study's slight female preponderance (1.1:1) concurs with existing literature attributing possible hormonal or social factors influencing disease distribution.

Clinically, the prominence of sebaceous carcinoma, especially the aggressive *meibomian gland carcinoma, underscores the necessity for heightened vigilance. Its potential to masquerade as benign inflammatory lesions like chalazion often delays diagnosis, contributing to worsened outcomes. Current diagnostic advances leveraging immunohistochemical markers such as adipophilin and *p40* have substantially enhanced diagnostic accuracy for sebaceous and squamous cell carcinomas, respectively.

Parameter	Our Study (Nair et al.) (Hyderabad)	Chhetri et al. (Assam)	Mohan et al. (Kerala)	Sonagara et al. (Ahmedabad)	Chakrabarti et al. (Bhavnagar)	Anandani et al. (Ahmedabad)
Sample Size	1137	105	414	205	50	230
Study Period	2014-2024 (10 years)	2018-2023 (5 years)	2006-2015 (10 years)	2018 (1 year)	2020-2023 (2.5 years)	2008–2014 (6 years)
Mean/Range Age (years)	Mean 39.7 (1 - 90)	Mean 40 (1 - 79)	Mean 43.4 (1 - 90)	Mean 42.75 (2 m - 80)	Mean 42 (2 m – 80)	Mean 40 (<10 to>80)
Gender Ratio (M:F)	1:1.23 (F slight predominance)	1:1.14 (F slight predominance)	1:1.3 (F-predominance	1:1 (equal)	1:1 (equal)	1.37:1 (M-predominance)

Benign Lesions %	41%	89%	52.4% non-neoplastic, 37.7% benign	47.32% non-neoplastic, 16.09% benign	56% non-neoplastic, 20% benign	69.56%
Malignant Lesions %	16%	11%	9.9%	36.58%	24%	30.43%
Common Benign Lesions	Intradermal nevus	Chalazion, Epidermal cyst	Epidermal cyst, Nevus	Dermoid cyst, Intradermal nevus	Epidermal cyst	Nevus,Epider-mal cyst
Common Malignant Lesions	Meibomian gland carcinoma (8.9%)	Sebaceous gland carcinoma, Basal cell carcinoma	Sebaceous carcinoma (2.4%), Basal cell carcinoma	Squamous cell carcinoma (13.65%), Meibomian gland carcinoma	Basal cell carcinoma	Squamous cell carcinoma, Sebaceous cell carcinoma
Age Group Affecting Lesions	Benign: 20-59 yrs, Malignant: >60	Benign: 40-59 yrs, Malignant: >60yrs	Benign: 5th decade, Malignant: 6th decade	Benign: 41-50, Malignant: 61-70	Benign & Malignant all ages	Benign: 20-50, Malignant: >60yrs
Gender Distribution pattern	Female predominance	Female predominance	Female predominance	Males more affected	Equal sexes	Males more affected

Comparison with International Studies

Our findings demonstrate several notable similarities and differences compared to international studies. Huang et al. in their comprehensive Chinese study of 2,228 eyelid tumors reported 85.7% benign lesions and 13.1% malignant lesions, closely paralleling our observations [7]. However, their study showed a higher percentage of benign lesions, possibly reflecting differences in referral patterns and population demographics.

Banerjee et al. in their twenty-year retrospective analysis from Chennai, India, studying 994 cases found sebaceous gland carcinoma (SGC) comprising 55.7% of malignant lesions, followed by basal cell carcinoma (21.1%) [8]. This pattern strongly correlates with our findings, where meibomian gland carcinoma comprised 48.3% of malignant lesions, confirming the established Asian predilection for sebaceous gland malignancies.

Conversely, Western studies typically report basal cell carcinoma as the most common eyelid malignancy. Deprez et al. in their analysis of 5,504 eyelid skin tumors from Switzerland reported basal cell carcinoma comprising 80-90% of malignant lesions [9]. This stark difference highlights the significant ethnic and geographical variations in eyelid tumor epidemiology, likely reflecting genetic predisposition, environmental factors, and possibly diagnostic practices.

Bagheri et al. in their Iranian study of 331 eyelid tumors reported 85.8% benign lesions, with papilloma (19.7%) and nevus (13.7%) as the most common benign diagnoses [10]. While our study similarly identified nevus as the most common benign lesion, the higher prevalence of epidermoid cysts in our series suggests possible regional or methodological differences.
Kaliki et al. in their landmark study of 191 Asian Indian patients with sebaceous gland carcinoma reported a mean age of 57 years and female predominance (male-to-female ratio 1:1.4) [11]. These demographic patterns closely mirror our findings, reinforcing the consistency of sebaceous gland carcinoma characteristics within the Indian subcontinent.

Dasgupta et al. in their two-year study of meibomian carcinoma from Kolkata reported a mean age of 55 years with 66.7% female predominance [12]. Their emphasis on the aggressive nature of these tumors and the importance of early diagnosis aligns with our clinical experience and reinforces the critical need for heightened awareness among clinicians.

Clinical Implications and Diagnostic Challenges

The high prevalence of meibomian gland carcinoma in our series carries significant clinical implications. Shields et al. demonstrated that these tumors are notorious for their ability to masquerade as benign conditions, particularly chalazion, leading to diagnostic delays and potentially devastating consequences [13]. The aggressive biological behavior of sebaceous gland carcinomas, including their propensity for local invasion, lymphatic spread, and distant metastasis, underscores the critical importance of maintaining high clinical suspicion for malignancy in atypical or persistent eyelid lesions.

The age-related distribution patterns observed in our study provide valuable guidance for clinical practice. The predominance of malignant lesions in patients over 60 years suggests the need for heightened vigilance in elderly populations, where even seemingly benign lesions warrant careful evaluation and potentially early biopsy.
Regional Variations and Population-Specific Patterns

Our study reveals interesting demographic patterns that differ from Western populations. The slight female predominance (55.1% vs 44.9% males) in our cohort contrasts with some Western studies but aligns with other Asian reports. This gender distribution may reflect cultural, occupational, or genetic factors specific to the South Indian population.

The mean age of 39.7 years for all eyelid lesions in our study is notably younger than many Western reports, possibly reflecting the demographic structure of the Indian population or differences in healthcare-seeking behavior. The concentration of cases in the third, fourth, and sixth decades (46.17% of total) suggests that middle age represents a critical period for eyelid pathology in our population.

Study Strengths

The study's strengths include the large sample size spanning a decade, comprehensive demographic analysis, and systematic use of immunohistochemical markers in challenging cases. The tertiary care setting ensures a diverse and representative patient population, while the extended study period allows for meaningful trend analysis and reduces the impact of temporal variations in referral patterns.

Future Directions and Research Implications

The findings of this study provide a foundation for several future research directions. Prospective studies incorporating molecular analysis could provide deeper insights into the pathogenesis of common eyelid lesions, particularly meibomian gland carcinoma. Cost-effectiveness analyses of routine immunohistochemical staining versus morphology-based diagnosis could inform optimal diagnostic protocols and healthcare resource allocation.

The establishment of regional databases for eyelid pathology could facilitate multi-institutional collaborative studies, enhancing our understanding of geographical and ethnic variations in lesion distribution. Such initiatives could ultimately contribute to improved screening protocols and treatment guidelines tailored to specific populations.

Additionally, the development of artificial intelligence-based diagnostic tools using histopathological images could potentially improve diagnostic accuracy and reduce inter-observer variability, particularly in resource-limited settings where experienced pathologists may not be readily available.

CONCLUSION

This decade-long series of 1,137 eyelid lesions from South India shows a predominance of benign entities yet a clinically meaningful burden of malignancy, with meibomian (sebaceous) gland carcinoma emerging as the leading cancer and warranting vigilant evaluation and routine histopathologic confirmation of suspicious lesions. The consistent diagnostic utility of immunohistochemistry—particularly p40 for squamous cell carcinoma, adipophilin for sebaceous carcinoma, and Ber-EP4 for basal cell carcinoma—highlights the value of integrating targeted markers with morphology to resolve challenging differentials and optimize accuracy. Demographic and anatomic trends, including age-linked malignancy risk and sex-specific patterns, offer practical guidance for triage and surveillance, while contrasts with Western cohorts (e.g., higher sebaceous carcinoma frequency compared with basal cell carcinoma) underscore the need for region-tailored screening and management pathways. Alignment with prior Indian data reinforces the predominance and aggressiveness of sebaceous carcinoma in this setting; together with literature emphasizing early recognition, the findings support a low threshold for biopsy of persistent or atypical chalazia-like lesions. Priorities for next steps include prospective, multi-center studies with uniform staging, molecular profiling of common tumors, and outcome-linked biomarker validation to refine risk stratification and inform therapy. Overall, these results expand regional epidemiology, affirm histopathology as the diagnostic cornerstone, and provide actionable patterns to guide clinical pathways, resource planning, and evidence-based protocols for eyelid lesions in similar populations.

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