

# Pilomatricoma: A Clinical and Histopathologic Study of 13 Cases

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**Background :** Pilomatricoma is a rare benign follicular tumor in Asians.

**Objective:** The purpose of this study was to assess the clinical and histopathological features of the tumor.

**Methods :** The hospital charts and slides of 13 patients with pilomatricoma over a 12-year period at Ewha Womans University Tongdaemun Hospital were retrospectively reviewed.

**Results :** The age of patients ranged from 5 to 76 years with a mean of 21.5 years. The male-to-female ratio was 1:3.3. Seventy-seven percent of the tumors were located on the upper and lower extremities, followed by the face and neck. Most tumors appeared as a pea-sized hard movable skin-colored nodule. At histopathologic level, the most common morphological stage was the early regressive stage (stage 3), followed by late regressive (stage 4), fully developed (stage 2), and early (stage 1) stages. Foreign body giant cells, calcification, ossification were seen in 69.2%, 84.6%, and 7.7%, respectively; giant cells and inflammatory infiltrate were mostly seen in stage 3 tumors, calcification in stage 3 and 4 tumors, and ossification, only in the sole stage 4 tumor. Anetodermic changes of overlying dermis were seen in 2 cases (15.4%).

**Conclusion :** The various histopathologic features of pilomatricoma can be explained by its chronological, morphological stages. Most pilomatricomas present for longer than 6 months are already in stage 3, and one can expect the histopathological features accordingly.

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Key Words : Pilomatricoma, Stages

Pilomatricoma is a benign cutaneous tumor with differentiation toward hair matrix, first described by Malherbe and Chenantais<sup>1</sup> in 1880 as calcifying epithelioma. The term pilomatricoma was suggested by Forbis and Helwig<sup>2</sup> in 1961, and this was later corrected to pilomatricoma, as more etymologically correct<sup>3</sup>. It usually presents as a hard dermal or subcutaneous tumor on the head, upper limbs, and upper trunk, with no established pattern of inheri-

tance<sup>4</sup>. Although previously reported to occur mostly in children and young adults, Taaffe et al<sup>5</sup> recently observed a second onset peak in adults and the elderly. More recently, Kadu et al<sup>6</sup> categorized the tumor into four distinct and chronological stages: early, fully developed, early regressive, and late regressive. We present a retrospective study of the clinicopathologic features of 13 pilomatricomas diagnosed at Ewha Womans University Tongdaemun Hospital from 1987 to 1998.

## MATERIALS AND METHODS

Thirteen cases from a 12-year collection from the Department of Dermatology at Ewha Womans University Tongdaemun Hospital were studied retrospectively. We reviewed the hospital charts and slides of 13 patients proven to have pilomatri-

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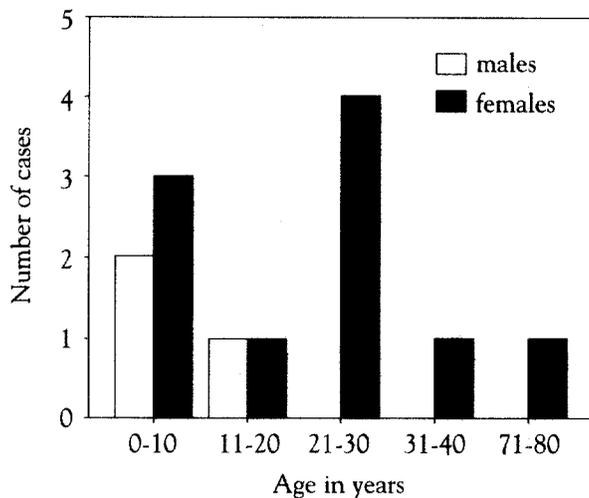


Fig. 1. Age and gender distribution.

comas by histopathological evaluations. Clinical evaluations were performed regarding the age, sex, tumor duration, site of origin, size, clinical appearance, preoperative diagnosis, and modality of treatment. Histopathologic slides were evaluated for features of calcification, ossification, encapsulation, foreign body giant cells, inflammation, cutaneous level, orientation, morphological stage, and associated anetoderma.

## RESULTS

### 1. Clinical features

From 1987 through 1998, the total number of patients who visited our institute was 701,108, including a total of 152,716 new patients and an approximate 13,000 new patients per year. The average incidence rate was 0.01% among the new patients. During this period, the number of patients with pilomatricomas was 13 (3 males, 10 females).

The youngest patient was 5 years of age, and the oldest, 76 years of age, with a mean of 21.5 years (Fig. 1). The peak age of presentation was up to 10 years in both male and female patients. There was a second, even higher peak in adult females between 21 and 30 years of age. Ten patients were female and 3 were male. The ratio of female to male patients was 3.3:1 overall but was 1:1 in patients under the age of 15. Most patients (12/13, 92.3%) had a tumor for no longer than 1 year. However, the time to diagnosis ranged from 3 weeks to 13 years with a mean of 1.6 years.

Table 1. Anatomic distribution of pilomatricomas

Location	Male	Female	Total (%)
Face	0	2	2 (15.4)
Neck	0	1	1 (7.7)
Upper extremities	2	3	5 (38.5)
Lower extremities	1	4	5 (38.5)
Total	3	10	13 (100.0)

Regarding the location of tumors (Table 1), the tumors were predominantly on the upper and lower extremities (76.9%). Face and neck lesions were seen in 23.1%. None were present on the scalp, palms, soles, or genitalia. Size of tumor at examination varied from 0.5 cm to 1.7 cm (mean, 1.02 cm) with most tumors (69.2%) between 0.5 and 1.0 cm. Most tumors appeared as a hard movable intracutaneous skin-colored nodule. One case with overlying anetodermic changes grossly appeared as a soft, telangiectatic, erythematous dome-shaped nodule. Two lesions appeared bluish. None were multiple.

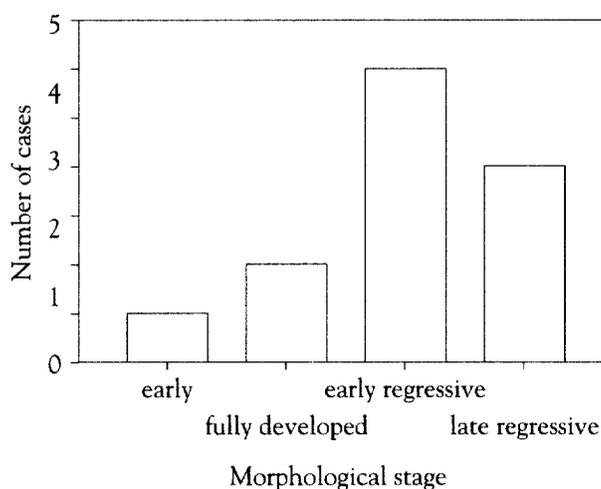
The correct preoperative diagnosis was made in 2 cases (15.4%). The most common clinical impression was that of an epidermal cyst (30.8%) with a wide range of other possible diagnoses, including calcinosis cutis (23.1%), glomus tumor (7.7%), neurofibroma (7.7%), phlebolith (7.7%), or pyogenic granuloma (7.7%).

Treatment of pilomatricomas was by excisional biopsy in all 13 cases. One tumor, which had the longest duration of 13 years, recurred in our series.

### 2. Histopathological features

The histologic condition is characteristic with transformation of tightly coherent epithelial cells with basophilic cytoplasm and a round vesicular nucleus to 'shadow cells' at the center of the tumor. Calcification, ossification, and foreign body giant cells were seen in 84.6%, 7.7%, and 69.2%, respectively. Connective tissue was surrounding the tumor, partially or completely, in 69.2%. Keratin pearl formation was seen in 46.2%. Cutaneous level of the tumor was dermis, lower dermis and subcutis in 46.2%, 46.2%, and 7.7%, respectively. The orientation of tumor was horizontal in 76.9% and vertical in 23.1%. Anetodermic changes (Fig. 2A-C) of the dermis overlying the tumor was seen in 2 cases (15.4%). None showed transepidermal

**Fig. 2.** A) Upper dermis showing increased vascularity and edematous appearance of the collagen (H & E;  $\times 40$ ). B, C) Special stains reveal edematous dermis, fragmented collagen fibers, and marked diminution of elastic fibers. Epidermis is normal (Verhoeff-van Gieson stain & Masson-trichrome stain;  $\times 20$ ).



**Fig. 3.** Relative frequency of morphological stages of pilomatricoma.

elimination, and no changes in particular were noted in the overlying epidermis. There were no melanin pigment, hemosiderin deposition, immature hair follicles or cholesterol clefts within or around the tumors.

Regarding the morphological stages (Fig. 3) of pilomatricoma as defined by Kaddu et al.<sup>6</sup>, 7.7% belonged to the early stage (Fig. 4A), 15.4% to the fully developed stage (Fig. 4B), 46.2% to the early regressive stage (Fig. 4C), and 30.8% to the late regressive stage (Fig. 4D). The longer the duration of the tumor, the higher the proportion of shadow cells and the stage; tumors over 6 months' duration were either in stage 3 or 4. Accordingly, calcification was present mostly in tumors in stage 3 and 4; ossification seen only in the sole case in stage 4. Connective tissue capsule was present in all stage 1 and 2 tumors but gradually disappeared in stage 3 and the majority of stage 4 tumors were de-

**Fig. 4.** A) Early lesion of pilomatricoma showing a relatively small cyst lined by basaloid epithelium (H & E,  $\times 20$ ). B) Fully developed lesion showing shadow cells surrounded by basaloid epithelium (H & E,  $\times 40$ ). C) Early regressive lesion mainly exhibiting densely packed zones of cornified eosinophilic material with shadow cells. In this stage, a moderately dense chronic inflammatory infiltrate with multinucleated histiocytic giant cells can be observed (H & E,  $\times 20$ ). D) Late regressive lesion mainly revealing irregularly shaped, partially calcified and ossified confluent masses containing shadow cells with no basaloid cell and with no inflammatory infiltrate. Note in the center bone marrow features with fat cells (H & E,  $\times 40$ ).

void of it. Inflammatory infiltrate and multinucleated histiocytic giant cells were mostly seen in stage 3 tumors and decreased in stage 4; none were seen in stage 1. Keratin pearl formation was present in all of stage 1 and 2 tumors but decreased to 50% in stage 3 and absent in stage 4.

## DISCUSSION

In the West, pilomatricomas are not uncommon, with a frequency of one in every 2000 surgical specimens received by pathologists in a large general hospital<sup>7</sup>; however, there is a racial difference in the incidence of the tumor. Among 153 cases in Moehlenbeck's series, 97.4% were Caucasian and only 1 case was Asian<sup>8</sup>. Korean investigators also reported the rarity of the tumor<sup>9,10</sup>. Our data support

the rarity of this tumor in Koreans: only about 1 patient out of 10,000 new outpatients had pilomatricoma.

Pilomatricomas usually appear in the first three decades of life<sup>5</sup> without an established pattern of inheritance<sup>4</sup>; however, many authors observed a second peak of onset in the elderly<sup>5,11,14</sup>. Our results also show most tumors presenting in the first three decades, but in later years the number of cases is too small to draw any conclusions about their incidence. The overall predominance of females with male-to-female ratio of 1:3.3 is in agreement with previous studies, which have reported ratios from 1:1.2-3<sup>5,6,8-14</sup>. The sex difference may be because females are more likely to demand removal of a cosmetic defect than male subjects<sup>5</sup>, since the gender ratio is 1:1 in patients under 15 years but after that age

there were only female patients. The clinical and histopathological features of adult patients were basically identical to those of younger patients.

Although in the foreign reports, pilomatricomas were situated mostly on the head and neck followed by the upper extremities, lower extremities, and only a few lesions on the trunk<sup>4,8,11-14</sup>. The Korean studies show the most frequent site of origin to be the upper extremities, accounting for more than 50%<sup>9,10</sup>. Our results are consistent with other Korean reports. Additionally, in our series, the lower extremities were as common a site as the upper limbs, contrary to other reports. Noguchi et al.<sup>13</sup> suggested that the distribution of pilomatricoma corresponds to the density of hair follicles at a particular site. The hairy scalp has about one half the density of follicles of the face, which is the most richly supplied area of the whole body. Our findings do not support this view, but a further study on a much larger number of cases is necessary in order to elucidate this apparent discrepancy or racial difference.

The association of multiple pilomatricomas with myotonic dystrophy is well recognized<sup>15</sup>; however, in our series none were multiple and none were associated with other diseases. Although most pilomatricomas have a firm calcified nodule, a few of them look vascular with associated skin thinning. Jones and Tschen<sup>16</sup> reported marked anetodermic skin changes occurring predominantly in young women. They postulated that catabolic enzymes from the tumor cells or associated inflammatory infiltrate might be responsible for this tissue destruction. Two of our cases showed this change: one on the upper arm of a seven-year-old boy, and the other on the cheek of a 76-year-old woman.

A typical histopathologic appearance of serially arranged rows of basophilic cells, transitional cells, and shadow cells is seen in almost all lesions, and the histologic diagnosis is seldom in doubt. The difficulty arises in interpreting the histopathogenesis of the lesions<sup>5</sup>. The putative association of pilomatricoma with other diseases has been offered as evidence for some unifying anomaly of hair follicle development<sup>17</sup>; however, there is no comprehensive theory as to its derivation. The subcutaneous location of many pilomatricomas was explained by some authors as partially formed dormant hair follicles lying too deep for inducing agents to exert their normal effects, which, on reactivation, only partially differ-

entiate and form a pilomatricoma<sup>5</sup>.

Kaddu et al.<sup>6</sup> identified four distinctive histopathologic stages in the evolution of this neoplasm: 1) early lesions are small cystic structures lined by squamoid and basaloid epithelium containing keratin filaments and faulty hair matrix material composed of shadow cells, 2) fully developed lesions are large neoplasms lined by basaloid epithelium at their periphery, and within, composed of irregularly shaped, densely packed zones of cornified masses containing shadow cells, 3) early regressive lesions with no apparent epithelial lining but some basaloid cell foci at the periphery are composed of pink hair matrix material with shadow cells surrounded by granulation tissue with inflammatory infiltrate and multinucleated histiocytic giant cells, and 4) late regressive lesions have no epithelial component and are composed of irregularly shaped, partially confluent masses of faulty hair material, and calcified (and sometimes metaplastically ossified) shadow cells embedded in a desmoplastic stroma, with little or no inflammatory infiltrate. We could observe the "life" of a pilomatricoma through these fairly well characterized, albeit overlapping, phases in the evolution of the tumor. In our series, the majority of the lesions were in stage 3 or 4, as in the series of Kaddu et al.<sup>6</sup>. Calcification is reported to develop in 69-95%<sup>2,4,8</sup> and ossification to be present in 10-20% of pilomatricomas in general. These figures merely indicate that most of the tumors in previous reports are in stage 3 and 4, and our data is in accordance with those large series.

In conclusion, pilomatricoma is a rare, benign tumor which is mostly histopathologically diagnosed. Although the tumor is much better known to emerge in children, it can also occur in late adulthood. In Koreans, the arms and legs seem to be the most common site of origin rather than the head and neck as in other races. The natural course of this neoplasm is a chronological process in which the lesion begins as an infundibular matrix cyst and ends up as a calcified and ossified nodule with no viable epithelial component and thus, we can anticipate what the histopathologic features of this tumor would be like from the duration of it.

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