# Dermatopathological Spectrum of Alopecias in Lagos Nigeria

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**ABSTRACT**

**Background:** Dermatopathological evaluation is the gold standard in hair loss management. It allows for specific diagnosis, precise therapies and prognosis. However, reports of dermatopathology based diagnoses of scalp hair loss are few in Nigeria. A study of the dermatopathological spectrum of scalp hair loss will reveal the commonly encountered types of hair loss and this will in addition aid in health care planning. **Objectives:** The study aimed to document and to correlate with clinical diagnoses, the dermatopathology diagnoses of hair loss. **Methodology:** This was a retrospective case review of 331 scalp biopsies evaluated for hair loss from 2015-2022 in Lagos, Nigeria. Standard laboratory processing, hematoxylin and eosin staining with relevant special stains and clinicopathologic correlation when necessary were done. Data was analyzed using SPSS version 23. **Results:** Three hundred and thirty one scalp biopsy samples from 251 patients were evaluated. The commonest dermatopathological diagnoses were central centrifugal cicatricial alopecia in 14.7%, folliculitis decalvans in 13.5%, alopecia areata in 13.5%, psoriasis in 12.8%, discoid lupus in 12.7%, lupus non-scarring alopecia in 4.2%, lichen planopilaris in 4% and androgenetic alopecia in 4%. The correlation between dermatopathological diagnosis with provisional clinical diagnosis was concordant in 75.7% of cases. **Conclusion:** Central centrifugal cicatricial alopecia and folliculitis decalvans are the commonest reasons for scalp biopsies. Clinicopathologic correlation is high for scalp hair loss. Dermatopathological evaluation is important in the definitive evaluation and management of hair loss. Age and gender influence the types of hair loss.

**Keywords:** Hair loss, Biopsy, Dermatopathology, Alopecia

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## INTRODUCTION

Hair loss is not uncommon and accounts for 1.3 to 66.3% of dermatological consultations.[1-3] It occurs in all age groups and is a world-wide phenomenon. Dermatopathological evaluation is central to the management of hair loss (HL) as it leads to a definitive diagnosis and a definitive

treatment.[4-7] The commonly diagnosed dermatopathologic causes of HL include central centrifugal cicatricial alopecia (CCCA), folliculitis decalvans (FD), alopecia areata (AA), psoriasis (Ps), discoid lupus erythematosus (DLE), seborrhoeic dermatitis (SD), lupus non scarring alopecia (Lupus NSA), androgenetic alopecia (AGA), lichen piano pilaris (LPP), dissecting cellulitis (DCT).[7-11] The dermatopathologic diagnosis of HL is based on the pattern and inflammatory infiltrates observed.[6,7,9,12] Studies of HL dermatopathology reveal a high clinicopathologic correlation of 81 to 83%.[8,13]

Although, reports of dermatopathological diagnoses of skin diseases and of their clincopathologic correlations (CPC) exist in Nigeria, there are no studies of the dermatopathology of HL despite a high prevalence of HL in the clinics.[1,14,15,16] A knowledge of the spectrum of the common types of hair loss is important especially in planning for restorative hair procedures. It allows for precision in patient management. In addition, knowing the common types of HL allows for health planning; acquisition of equipment and the training of health care workers on the management of these diseases. The objective of this study was to document the spectrum of dermatopathological diagnoses of HL over a seven-year period and to determine the degree of clinicopathologic correlation.

## METHODOLOGY

A retrospective review of 331 scalp biopsies done from 2015 to 2022 was conducted in 2023. Data collection took place following approval from the ethics review board of the Lagos State University Teaching Hospital, Lagos, Nigeria (LREC/06/10/1837). The dermatopathology registry of the laboratory was reviewed, and the following information was recorded: gender, age at the time of biopsy, duration of hair loss, number of scalp biopsies per patient, clinical and dermatopathological diagnoses. Vertical and Cross-sectional sections were conducted. The cross-sectioning was done according to the recommendation of Headington.[17,18] The vertical sections were evaluated for hyperkeratosis, parakeratosis, epidermal atrophy, acanthosis, interface changes, type of inflammatory infiltrates, morphology of hair follicles and presence or absence of sebaceous glands.

The cross-sectioned specimens were evaluated for follicular counts, miniaturization of hair follicles, fibrous stellae, telogen percentage, terminal vellus hair ratio, inflammatory infiltrates, perifollicular fibroses, bulbar infiltrates and the presence or absence of sebaceous glands. The biopsies were processed according to standard laboratory procedures at the ClinaLancet Laboratories, Victoria Island in Lagos, Nigeria. Both the vertical and cross-sectional specimens were stained with hematoxylin and eosin (H & E). Additionally, Alcian blue stain (pH 2.5) for mucin evaluation was done as necessary. All specimens were fixed in 10% formalin, embedded in paraffin, and stained with hematoxylin and eosin for routine histologic examination.

Included in the study were all scalp biopsies for hair loss with a definitive dermatopathology diagnosis. Excluded from the study were scalp biopsies reports that were not diagnostic either for reasons of insufficient biopsies or a diagnosis of other scalp diseases like cysts, naevi and other tumours. This being a retrospective study, incomplete data on age (8 patients) and duration (74 patients) of hair loss were noted in a few patients. Since this did not affect the dermathopathology diagnosis of the disease, these patient's data were included in the analysis.

### Data Analysis

Data was exported from Excel to the IBM Statistical Package for Social Sciences, version 25. All the scalp diseases were categorized into eighteen major disease categories and presented as frequencies and percentages.

## RESULTS

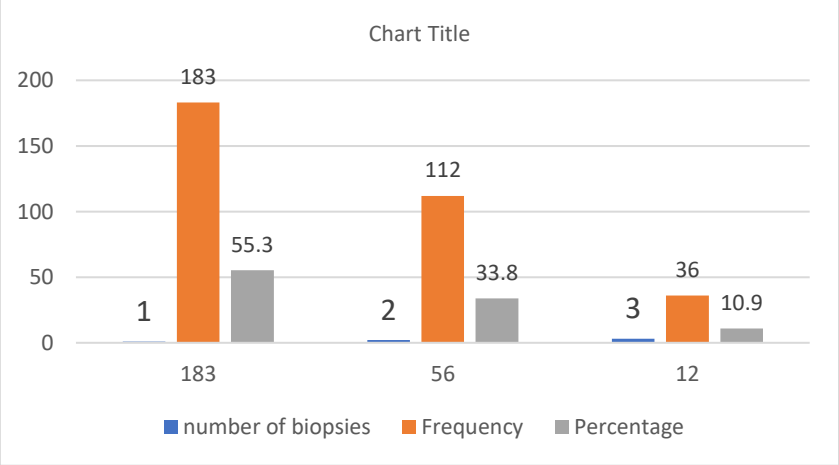
In the period under review, a total of 3,098 skin biopsies from 2,969 patients were reported. Scalp biopsies from 251 patients accounted for 331/3098

(10.7%) of the biopsies. The study participants were 65.3% female and 34.7% male, had an age range of 6 to 72 years and a median age of 36 (IQR 28, 44) years. The 30-49 years age group accounted for most of the biopsies. The duration of scalp hair loss varied from 0.1 to 25 years with a median of 2.0 (IQR 0.77, 5.0) years. Most of the individuals waited for 1-4 years before having a biopsy done. Although a total of 331 scalp biopsies were conducted amongst the 251 patients, mostly one biopsy sample was done per person(Table 1 & Figure 1).

**Table 1.** Sociodemographic features of patients

| Variable | n = 251 | % |
|---|---|---|
| **Age group (years)** | | |
| < 19 | 23 | 9.2 |
| 20- 29 | 43 | 17.1 |
| 30 - 39 | 84 | 33.5 |
| 40 - 49 | 52 | 20.7 |
| 50 - 59 | 31 | 12.4 |
| >= 60 | 10 | 4.0 |
| No response | 8 | 3.2 |
| **Duration (year)** | | |
| < 1 | 45 | 17.9 |
| 1 - 4 | 85 | 33.9 |
| 5 - 9 | 26 | 10.4 |
| 10 - 14 | 15 | 6.0 |
| >=15 | 6 | 2.4 |
| No response | 74 | 29.5 |

**Figure 1.** Histogram showing number of patients and number of scalp biopsies




A definitive dermatopathological diagnosis was made in 244/251 (97.2%) of the cases and clinicopathological correlation was 75.7%. A total of 18 diagnoses were made. Scarring alopecia accounted for 135/251 (53.8%) of the diagnoses(Table 2). The commonest and the least diagnosed diseases are as detailed in Table 2 and Figures 2 to 5. A diagnosis of end stage scarring alopecia with no specific etiology was made in 6/251 (2.4%).

**Table 2.** Dermatopathological diagnosis and frequencies

| Pathological diagnosis | Frequency | Percentage |
|---|---|---|
| Central centrifugal cicatricial alopecia | 37 | 14.7 |
| Folliculitis decalvans | 34 | 13.5 |
| Alopecia areata | 34 | 13.5 |
| Psoriasis | 33 | 13.1 |
| Discoid lupus | 32 | 12.7 |
| Seborrhoeic dermatitis | 28 | 11.2 |
| Lupus non scarring alopecia | 14 | 5.0 |
| Androgenic alopecia | 10 | 4.0 |
| Lichen piano pilaris | 10 | 4.0 |
| End scarrring alopecia | 6 | 2.4 |
| Traction alopecia | 4 | 1.6 |
| Telogen effluvium | 3 | 1.2 |
| Dissecting cellulities | 3 | 1.2 |
| Lichen simplex chronicus | 1 | 0.4 |
| Acne Keloidale nuchae | 1 | 0.4 |
| Brunsting Perry pemphigoid | 1 | 0.4 |

**Figure 2A.** Clinical picture of Central centrifugal cicatricial alopecia showing alopecic patch

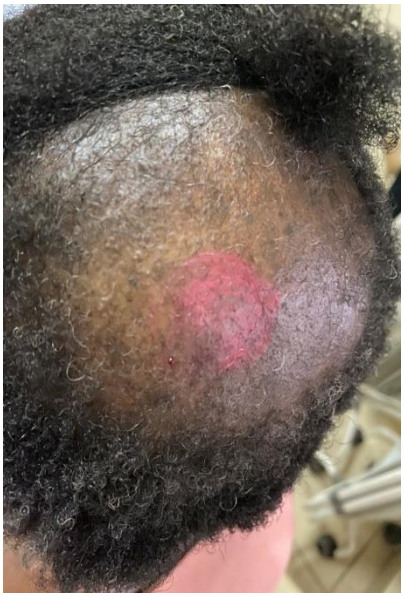


**Figure 2B.** Photomicrograph of Central centrifugal cicatricial alopecia showing miniaturized hair follicles (blue arrow), naked arrector pilli muscle (black arrow) and perifollicular fibrosis (orange arrow). H& E X20 magnification

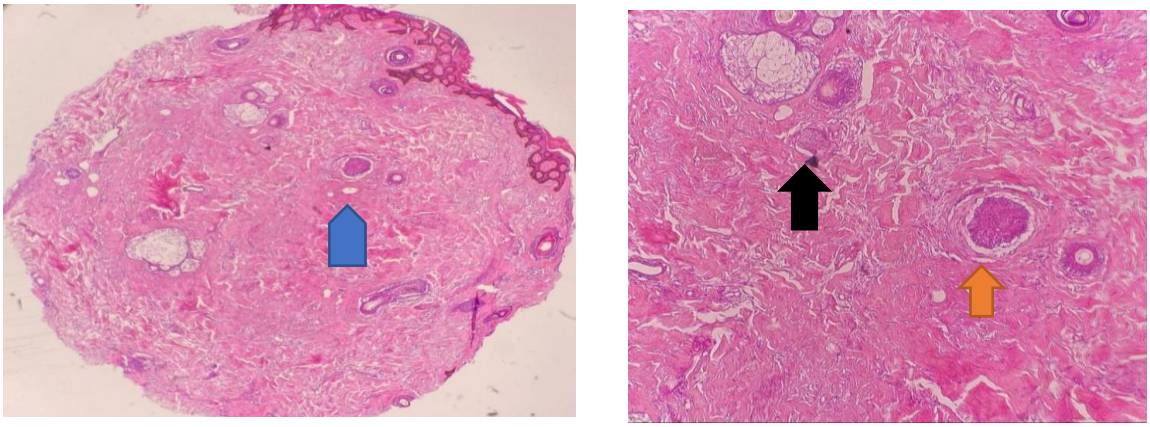


**Figure 3A.** Folliculitis decalvans (a)showing abscess (blue arrows) and dissecting cellulitis (b) showing ulcerations (green arrow) and scab (blak arrow)

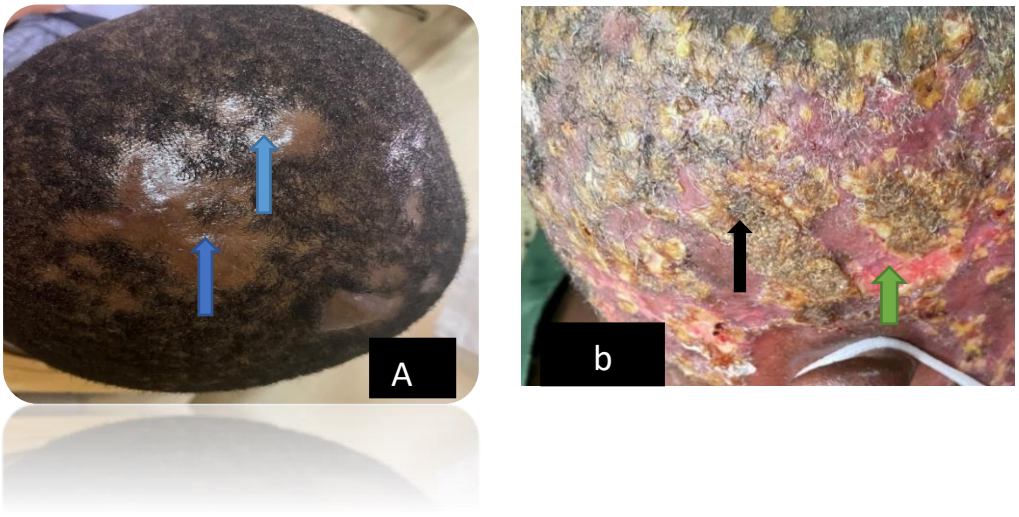



**Figure 3B.** Photomicrograph of Folliculitis decalvans: Neutrophilic abscesses (blue arrows). H& E X20magnification

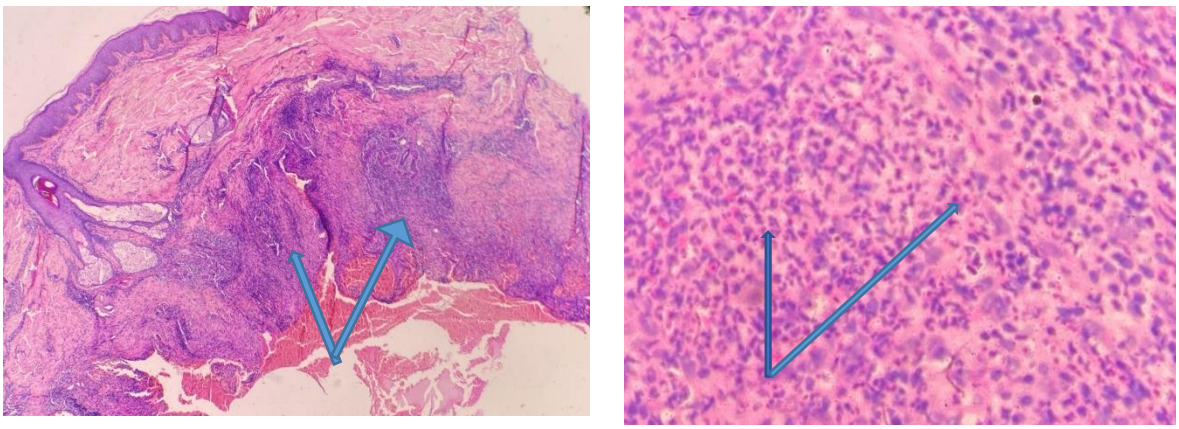


**Figure 4A.** Discoid lupus. Alopecic patch with erythema (grey arrow), uleration (blue arrow) and scale (black arrow)

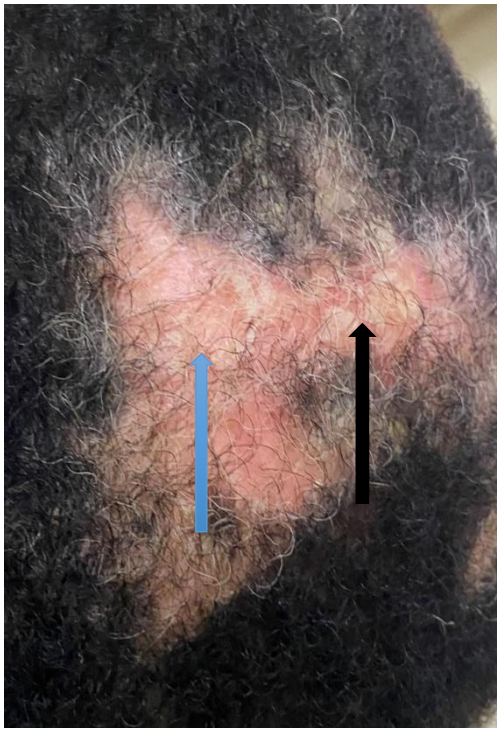
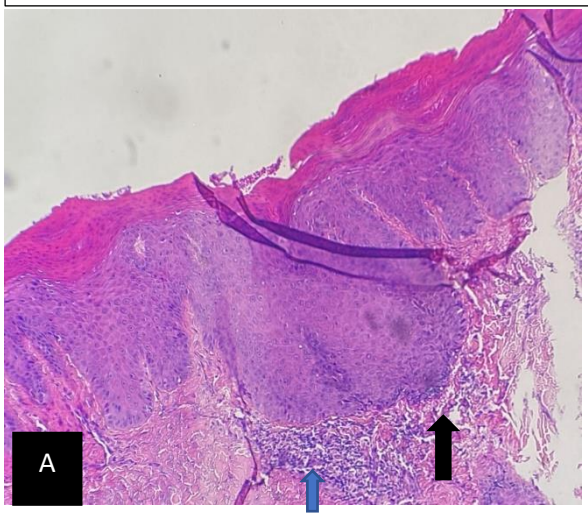


**Figure 4B (A &B).** Discoid Lupus. Black arrow: basal vacuolation, blue arrow: lichenoid infiltrates, orange arrow: perifollicular fibrosis, green arrow: perifollicular infiltrates and abscent sebaceous glands. Grey arrow: naked arrector pilli muscle H& E X20 magnification



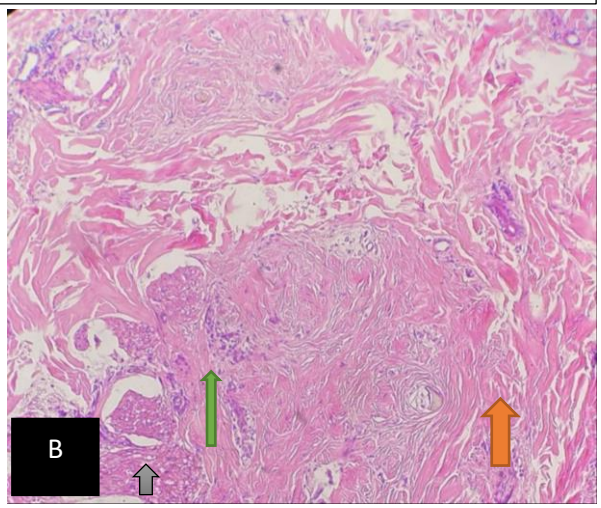
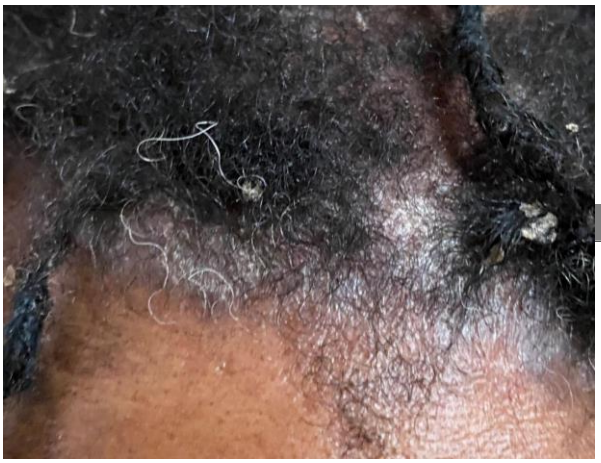




**Figure 5A.** Psoriasis: Scale and alopecic patches

**Figure 5B.** Psoriasis. Black arrow: parakeratosis, hyperkeratosis. Orange arrow: absent granular layer. Green arrows: thin suprapapillary plate.Blue arrow: acanthosis H& E X20 magnification



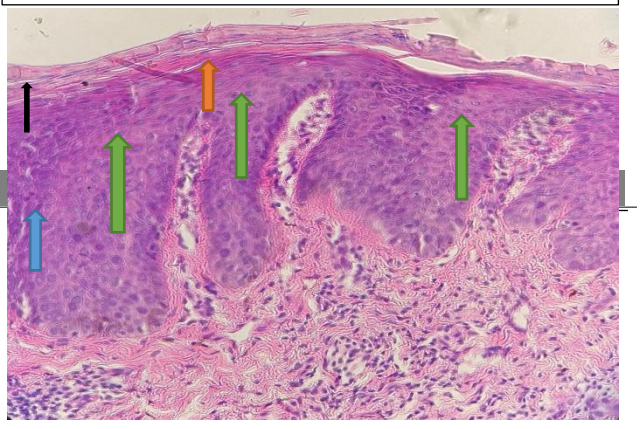


**Table 3** shows the spectrum of dermatopathological diagnoses based on gender. Alopecia areata, CCCA, DLE, psoriasis, lupus NSA, traction alopecia and telogen effluvium were more common in females while folliculitis decalvans, AKN and dissecting cellulitis were more common in male.

**Table 3.** Gender based spread of dermatopathological diagnosis

| Pathological Diagnosis | Male n = 85 (%) | Female n = 165 (%) | Total |
|---|---|---|---|
| Central centrifugal cicatricial alopecia | 1 (1.2) | 36 (21.8) | 37 |
| Folliculilitis decalvans | 31 (36.0) | 4 (2.4) | 35 |
| Alopecia areata | 14 (16.3) | 20 (12.1) | 34 |
| Discoid lupus erythematosus | 9 (10.5) | 24 (14.5) | 33 |
| Psoriasis | 9 (10.5) | 24 (14.5) | 33 |
| Seborrhoeic dermatitis | 10 (11.6) | 18 (10.9) | 28 |
| Lupus non-scarring alopecia | 1 (1.2) | 13 (7.9) | 14 |
| Lichen plano pilaris | 4 (4.7) | 6 (3.6) | 10 |
| Androgenetic alopecia | 2 (2.3) | 8 (4.8) | 10 |
| Telogen effluvium | 0 (0.0) | 7 (4.2) | 7 |
| End stage scarring alopecia | 1 (1.2) | 5 (3.0) | 6 |
| Traction alopecia | 0 (0.0) | 4 (2.4) | 4 |
| Dissecting cellulitis | 2 (2.4) | 1 (0.6) | 3 |
| Brunsting perry pemphigoid | 1 (1.2) | 0 (0.0) | 1 |
| Acne keloidale nuchae | 1 (1.2) | 0 (0.0) | 1 |
| Lichen simplex chronicus | 1 (1.2) | 0 (0.0) | 1 |

When dermatopathological diagnoses were compared based on age group, the only form of HL in young people was alopecia areata. Most of the other diseases were diagnosed in the 30-49 years age group and predominantly in the 30-39 years age group (Table 4).

**Table 4.** Dermatopathological diagnosis by age group

| Pathological diagnosis | <20 n = 23 (%) | 20- 29 n = 43 (%) | 30 – 39 n = 85 (%) | 40 - 49 n= 52 (%) | 50 - 59 n = 31 (%) | >60 n = 10 (%) | Total |
|---|---|---|---|---|---|---|---|
| Alopecia areata | 13 (56.5) | 7 (16.3) | 8 (9.4) | 3 (5.8) | 3 99.7) | 0 (0.0) | 34 |
| Androgenetic alopecia | 0 (0.0) | 1 (2.3) | 5 (5.9) | 4 (7.7) | 0 (0.0) | 0 (0.0) | 10 |
| Central centrifugal cicatricial alopecia | 1 (4.3) | 4 (9.3) | 16 (18.8) | 8 (15.4) | 7 (22.6) | 0 (0.0) | 36 |
| Discoid lupus | 0 (0.0) | 2 (4.7) | 15 (17.6) | 9 (17.3) | 2 (6.5) | 4 (40.0) | 32 |
| Folliculilitis decalvans | 2 (8.7) | 11 (25.6) | 13 (15.3) | 5 99.6) | 3 (9.7) | 0 (0.0) | 34 |
| Lichen plano pilaris | 0 (0.0) | 3 (7.0) | 2 (2.4) | 2 (3.8) | 2 (6.5) | 0 (0.0) | 9 |
| Lupus non-scarring alopecia | 2 (8.7) | 2 (4.7) | 4 (4.7) | 3 (5.8) | 2 (6.5) | 1 (10.0) | 14 |
| Psoriasis | 2 (8.7) | 4 (9.3) | 11 (12.9) | 10 (19.2) | 3 (9.7) | 1 (10.0) | 31 |
| Seborrhoeic dermatitis | 2 (8.7) | 7 (16.3) | 6 (7.1) | 4 (7.7) | 4(12.9) | 4 (40.0) | 27 |
| Telogen effluvium | 0 (0.0) | 1 (2.3) | 5 (5.9) | 0 (0.0) | 1 (3.2) | 0 (0.0) | 7 |
| End stage Scarring Alopecia | 0 (0.0) | 0 (0.0) | 1( 1.2) | 3 (5.7) | 2 (6.4) | 0 (0.0) | 6 |
| Brunsting perry pemphigoid | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (1.9) | 0 (0.0) | 0 (0.0) | 1 |
| Acne keloidalis nuchae | 0 (0.0) | 1 (2.3) | 0 (0.0) | 0(0.0) | 0 (0.0) | 0 (0.0) | 1 |
| Lichen simplex chronicus | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 ( 3.2) | 0 (0.0) | 1 |
| Dissecting cellulitis | 1 (4.3) | 0 (0.0) | 1 (1.2) | 0 (0.0) | 1 (3.2) | 0 (0.0) | 3 |
| Traction alopecia | 0 ((0.0) | 1 (2.3) | 2 (2.4) | 0 (0.0) | 1 (3.2) | 0 (0.0) | 4 |

## DISCUSSION

Reports of scalp biopsies are not readily available in Nigeria despite HL accounting for a 1- 6% of dermatological consultations in the country.[1,2,19,20] This study demonstrates a high clinicopathologic correlation for scalp alopecias. In addition, the study reveals that, it's the scarring form of alopecia that is frequently biopsied and the most frequently biopsied types of hair loss(HL) are central centrifugal cicatricial alopecia (CCCA), folliculitis decalvans

(FD), discoid lupus (DLE), seborrheic dermatitis (SD) and psoriasis.

Less than half of the participants in our study had more than one scalp biopsy. In the evaluation of alopecias, at least two 4mm punch samples are advised for cross-sectional and vertical evaluations. This is because vertical samples are better for the evaluation of epidermal changes and cross-sections for details of follicular features.[17,18,21] This study demonstrates a need for a better relationship between the dermatologist and the dermatopathologist for appropriate and adequate biopsies.

**Pattern and Types of Alopecia**

A scarring form of alopecia was diagnosed in over half of the patients. This correlates with scarring alopecia being the prevalent reason for dermatological consultation for hair and scalp diseases.[1,15,22] In alignment with our study, scarring alopecia is the most frequently diagnosed form of alopecia in similar studies.[10,13]

The most diagnosed form of HL in the study was CCCA. This form of alopecia is the most frequently biopsied type of hair loss because: it is a disease with an uncertain aetiology, affects mostly females, it is symptomatic, diagnosed mostly in Africans and people of African descent and not amenable to self-medication.[9] Ho *et al* in the study of the histopathology alopecias in Jamaicans similar to our study reported CCCA as a foremost reason for a scalp biopsy.[8] Central centrifugal cicatricial alopecia (CCCA) is variously reported to be a common scarring alopecia in people of African descent and our study population is African.[8,9,13]

The next most frequently diagnosed disease was alopecia areata (AA). Alopecia areata is an autoimmune disease that affects mostly young and middle aged individuals. It is a non-scarring form of hair loss that can be bewildering to patients.[1,22] Diagnosis of AA is enhanced by the finding of peribulbar infiltrates and fibrous stellae.[7] The young age of those affected may be the reason for the frequency of pathological evaluation. The prevalence of AA in histopathology studies varies based on the study population and the geographical location of the study because AA is readily diagnosed clinically. Ho *et al* in Jamaica and Hashmi *et al* in India reported a lower prevalence of AA than that in this study.[8,10]

Folliculitis decalvans, a scarring form of alopecia was frequently diagnosed. Histopathological evaluation depends on the recognition of interstitial and perifollicular neutrophilic infiltrates, plasma cells and granulomas.[12,20] Folliculitis decalvans can be misdiagnosed to be dissecting cellulitis with which it has similar histopathologic features. What differentiates the two diseases is the depth of the infiltrates which is usually deeper in dissecting cellulitis. Although, the prevalence of FD varies from study to study, our study in consonance with other studies reveal FD not to be an infrequent histopathological diagnosis.[10,11,13,23-25]

Psoriasis and SD, two forms of non-scarring alopecia enjoyed almost the same frequency of diagnosis. Psoriasis unlike SD is uncommon in the West of Africa.[2,26] These two diseases are sometimes clinically indistinguishable when limited to the scalp and require a dermatopathological in put at arriving at the right diagnosis as their recommended treatment modalities differ.[27,28,29,30] Unlike our study, psoriasis and SD were not frequently reported in a similar study by Ho *et al*.[8] When a disease is common clinically, dermatologists tend to go ahead and treat it without a biopsy except when the disease is recalcitrant to treatment.[7] We are unsure if this is why these two diseases are not readily reported in other studies.

Discoid lupus, one of the primary cicatrial alopecia with an autoimmune basis was diagnosed with a low frequency. This may be associated with the low frequency of clinical diagnosis of this disease in our setting.[1,2,15] The frequency of DLE diagnosis varied in previous reports irrespective of if, the studies were specifically of scarring alopecias only or of both scarring and non-scarring alopecias. Some studies similar to ours had a low frequency of DLE,[8,11,24] while others had a high frequency of diagnosis.[10,13,23,25,31,32] These studies were all

retrospective with various durations of retrospection. This may have influenced the reported frequency of DLE or there is a true difference in the occurrence of DLE in these countries of study.

Brunsting Perry pemphigoid is a rare scarring immunobullous disease. It is not surprising that, it was one of the least made diagnosis in alignment with similar studies.[10,23] Acne keloidalis nuchae and TA were not frequently diagnosed as they are not common reasons for dermatological consultation with AKN reported in 4 to 14% and TA in 1.9 to 2.9% of dermatological consultations.[1,3,26,33,34,35] This may be because AKN and TA are mostly asymptomatic forms of alopecia. In addition, TA occurs commonly in the community, is reversible in it's early form, is amenable to self-treatment and preventative practices.[36.37] Similar to our study, AKN and TA were not readily reported in similar dermatopathological studies.[8,11,13,21] However, Su *et al* in Taiwan had a contrary high reportage of AKN.[24] Their study was over a 28-year period which was unlike our study and the other comparable studies which had durations of between two and seven years.

**Gender and Age Based Differences**

There was a gender based difference in the spectrum of dermatopathological diagnoses. Alopecia areata, CCCA, DLE, psoriasis, lupus NSA, TA and telogen effluvium were more common in females while folliculitis decalvans, AKN and dissecting cellulitis were more common in males. This difference is in alignment with the clinical prevalence of these diseases and the gender based difference in occurrence.[7,8,9,10,11,19] Traction alopecia occurs predominantly in females because of the hair care practices of this gender which involves the pulling of hair strands, excessive weight on the hair and the use of chemical relaxers which weaken the hair.[36,37] Lupus NSA and DLE are both autoimmune diseases documented to occur more in females.[38,39] On the hand, AKN is a disease associated with the shaving practice of African males and so occurs almost only in males.[36] Folliculitis decalvans and DCT are reported almost only in males and the reason for this being a predominantly male disease is not known.[10] Paradoxically, SD was diagnosed more in females although clinically it is reported more in males. This study had more females diagnosed to have psoriasis. Typically, scalp biopsies are done to differentiate between SD and psoriasis especially when the disease is limited to the scalp.[27,29] This may be the reason for the female preponderance of these diseases in the study. Overall, our study findings do not differ from similar dermatopathology studies.[10,11]

When dermatopathological diagnoses were compared based on age group, alopecia areata was found predominantly in the young. Alopecia areata typically has its onset in people less than 20 years of age thus, its occurrence in the young people in this study is not surprising. Most of the other diseases were diagnosed in the 30-49 years age group and predominantly in the 30-39 years age group. This may be because these diseases have an onset in the third decade of life.[12,38,39] Androgenetic alopecia was recorded in those aged 30 to 49 years in alignment with the age of onset of this form of HL. The only dermatopathology study in which age comparison was done reported a similar age group occurrence as this study.[12]

**Clinicopathologic Correlation**

The clinicopathologic correlation (CPC) of alopecia in this study was high. The reason for this high CPC could be that most of the clinical diagnoses and dermatopathology requests were made by dermatologists, a group of doctors familiar with these diseases. Also, most alopecias have a recognizable dermatopathological pattern thus reducing the difficulty in their diagnosis.[7,9,20] In addition, alopecias which have a similarity in dermatopathological pattern like lichen planopilaris and DLE can be further differentiated by the history provided on the request forms.[10] Ho *et al* and Zampella *et al* similarly demonstrated a high CPC in their studies and this was higher than that in this study.[8,13] They, like us, attributed this to the clinical accuracy and clinical description on the request forms by dermatologists.[8,13]

**Limitations**

The study was limited by its retrospective nature. Being a retrospective study, the information on the forms could not be interrogated in terms of missing age, gender and clinical diagnosis for some patients. The lack of clinical diagnosis in these request forms led to the exclusion of the data from these forms in the CPC.

## CONCLUSION

This study demonstrates a need for scalp biopsies in the evaluation of alopecias. It demonstrates a scarring form of alopecia as the most frequently biopsied, and the most frequent types are central centrifugal cicatricial alopecia, folliculitis decalvans, psoriasis, discoid lupus erythematosus and seborrhoeic dermatitis. There is an age and gender based difference in the occurrence of scalp disease. Traction alopecia, alopecia areata, central centrifugal cicatricial alopecia, discoid lupus and telogen effluvium are commoner in females while folliculitis decalvans, while acne keloidalis nuchae and dissecting cellulitis are commoner in males. Alopecia areata is commoner in young people while central centrifugal cicatricial alopecia, discoid lupus and other diseases are commoner in older individuals.

**Declarations**

**Study limitations:** The retrospective nature of the study was a limitation as the clinical information provided could not be further interrogated. This influenced the degree of CPC as requests without a clinical diagnosis could not be analyzed.

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**Conflict of interest:** the authors declare none.

**Ethical approval:** This was provided by the ethics review board of the Lagos State University Teaching Hospital, Lagos, Nigeria (LREC/06/10/1837).

**Informed consent:** Not applicable. This was strictly a case review

**Author role**

**ELA:** Conceptualization, literature review, data collection, write up, review of final document

**RMW:** Data collection, write up, review of final document

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**ABBREVATIONS**

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|---|---|---|
| 1. | Central centrifugal cicatricial alopecia | CCCA |
| 2. | Folliculitis decalvans | FD |
| 3. | Alopecia areata | AA |
| 4. | Psoriasis | Ps |
| 5. | Discoid lupus erythematosus | DLE |
| 6. | Seborrhoeic dermatitis | SD |
| 7. | Lupus non scarring alopecia | Lupus NSA |
| 8. | Androgenic alopecia | AGA |
| 9. | Lichen piano pilaris | LPP |
| 10. | Dissecting cellulitis | DCT |
| 11. | Clincopathologic correlations | CPC |
| 12. | Acne keloidalis nuchae | AKN |